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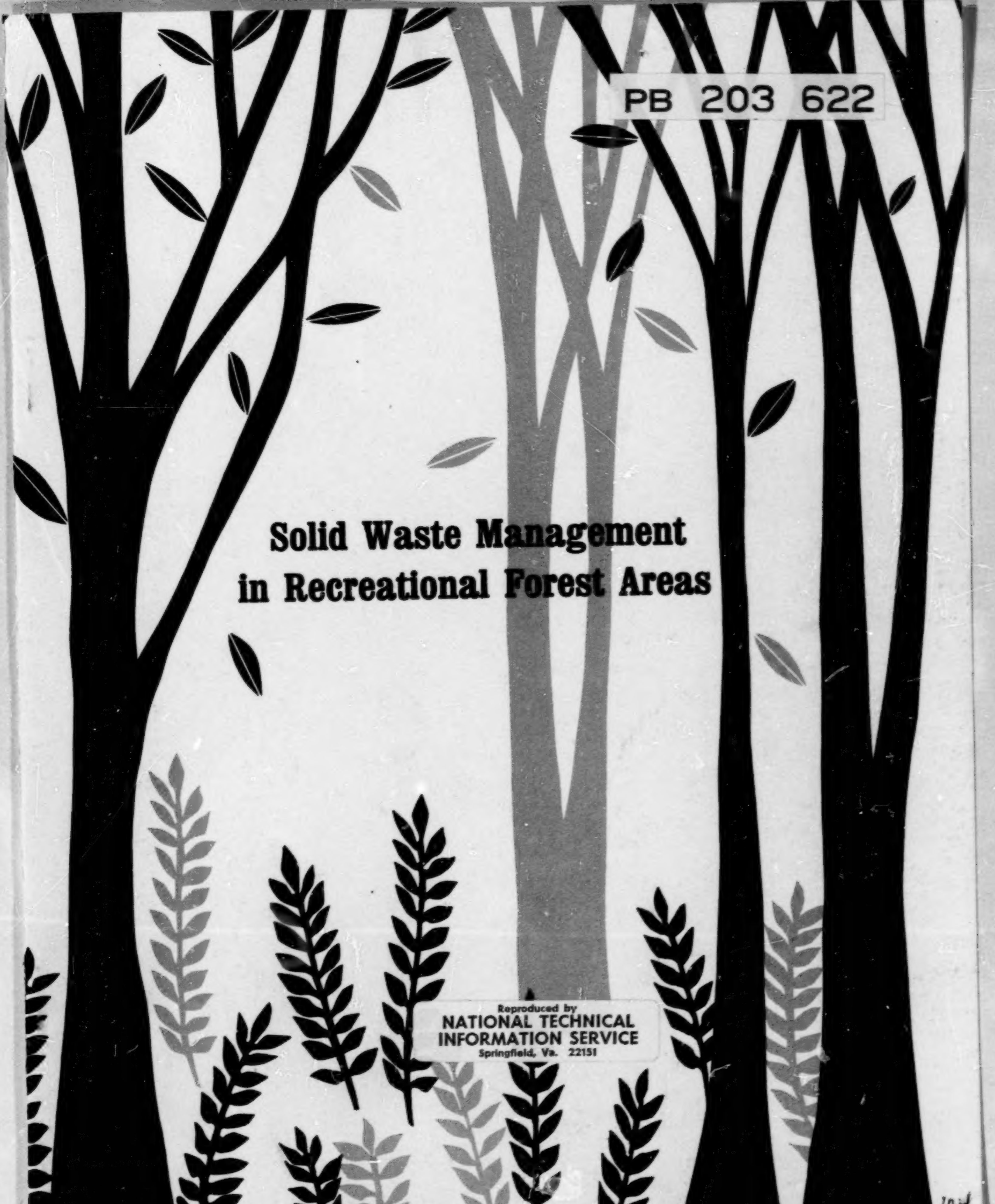

Solid Waste Management in Recreational Forest Areas

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A study was conducted in 1968 at selected Forest Service districts to establish waste generation rates for major recreational activities and to determine the cost of solid waste handling. Study teams collected solid waste from recreational areas during the study periods and weighed and sorted it into three categories: food wastes, other combustibles, and noncombustibles. Waste quantities produced by each recreational activity were correlated to the use the area had received during a 1-day period of waste acculation. The standard measure of recreational use was the "visitor day," defined as 12-hr use of a recreational facility by one person or use by many persons whose aggregate time in an activity equals 12 hr. Some of the results of the study were that generation rates did not vary regionally or with the level of campground development; that containers were well-designed and maintained; that land-disposal sites were de facto dumps, not operated to local, State, or Federal standards; and that the distance from the Forest Service recreational area to the disposal site and the intensity of recreational use in the area had the most influence on the cost of solid waste collection.

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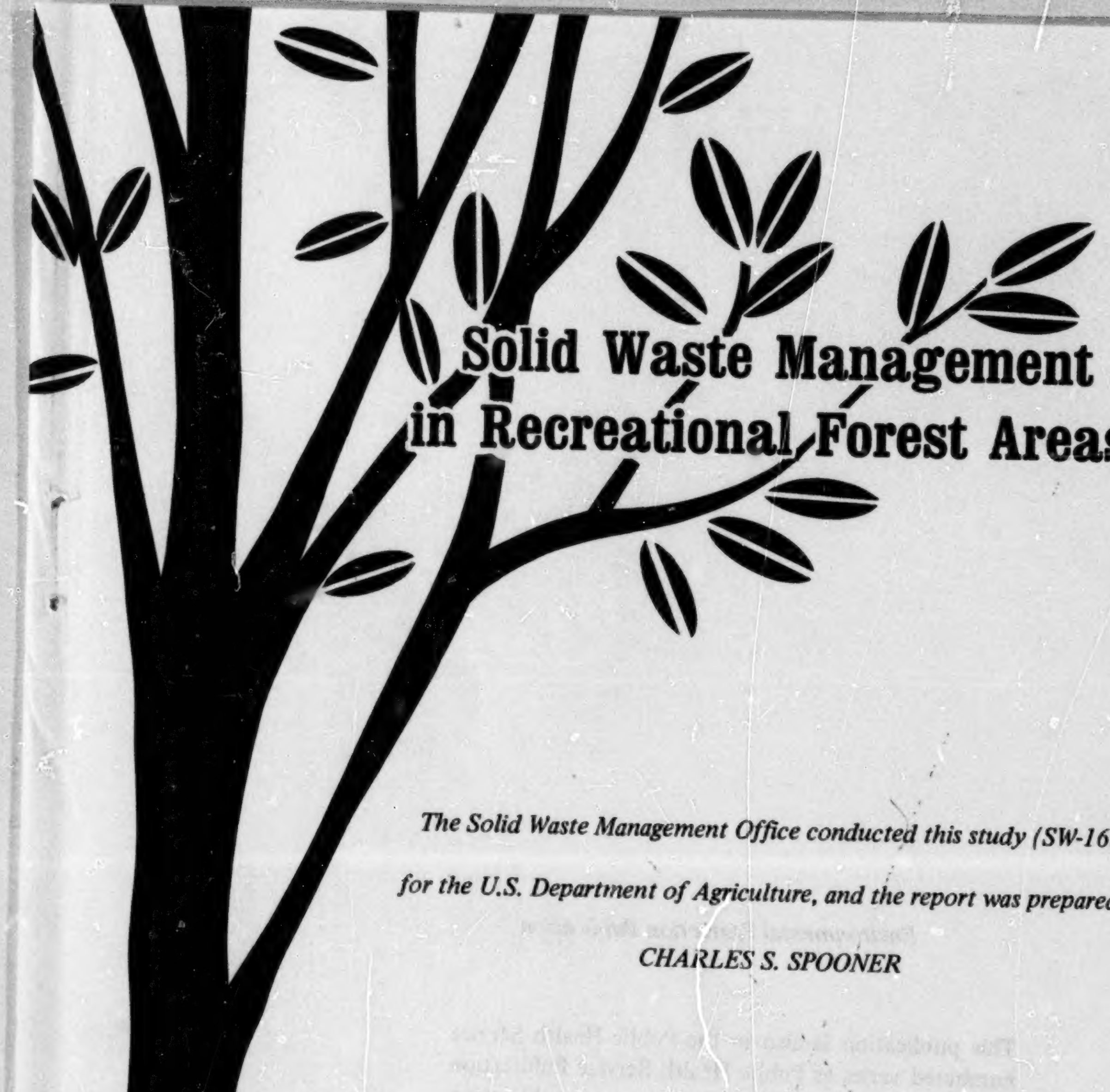

Solid Waste Management in Recreational Forest Areas

The Solid Waste Management Office conducted this study (SW-16ts)

for the U.S. Department of Agriculture, and the report was prepared by

CHARLES S. SPOONER

U.S. ENVIRONMENTAL PROTECTION AGENCY
Solid Waste Management Office
1971

FOREWORD

The Forest Service, U.S. Department of Agriculture, requested the Bureau of Solid Waste Management* to conduct a study of National Forest recreation areas. Its objectives were to establish waste generation rates for major recreation activities and to determine the cost of solid waste handling for selected Forest Service Districts. The study was implemented by the Forest Service's San Dimas Equipment Development Center in their Equipment Development and Testing (ED&T) Project 1848: "A Systems Study of Solid Waste Disposal." The present report (SW–16ts) resulted from the joint project and serves as both the Bureau of Solid Waste Management's report to the Forest Service and the ED&T project report.

The 1968 solid waste generation rates for all major recreation activities in the Forest Service are described, as well as the various methods of solid waste storage, collection, and disposal encountered. Some proposed changes of these practices are also discussed in this report.

Solid waste generation rates will enable officials to make more accurate estimates of the volume and the weight of wastes generated by various recreation uses and by new recreation facilities. These estimates will allow better selection of collection and disposal systems to meet expanding needs.

The report discusses the economics of, as well as the equipment used in, the various solid waste handling systems encountered during the study. Twelve Districts not visited were surveyed by letter and telephone. Data from these surveys provide a method of describing District solid waste handling costs and guides to reduce them.

The number of Americans visiting our parks and recreation areas has been growing rapidly. It is hoped that this report will assist in maintaining the beauty and healthfulness of these areas and in preserving them for the enjoyment of future generations.

RICHARD D. VAUGHAN
Assistant Surgeon General
Acting Commissioner
Solid Waste Management Office

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*This was the official name of the Federal solid waste management program at the time of this study, and thus is used throughout the report. The program has now been transferred from the U.S. Department of Health, Education, and Welfare to the U.S. Environmental Protection Agency.

Environmental Protection Publication

This publication is also in the Public Health Service numbered series as Public Health Service Publication No. 1991; its entry in two government publication series is the result of a publishing interface reflecting the transfer of the Federal solid waste management program from the U.S. Public Health Service to the U.S. Environmental Protection Agency.

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SUMMARY AND CONCLUSIONS

From the data for all the sites studied, the rate of waste generation for each activity was averaged and the 90 percent confidence interval was calculated (Table I).

The 22 cost questionnaires revealed that, although the budgeted amount for handling solid wastes in each District varied greatly, an average of 70 percent was spent on collection manpower and only 4 percent was spent on disposal. The remaining 26 percent was divided evenly between the cost of equipment and plastic liners. Collection and disposal costs per estimated ton ranged between $28 and $302 per ton, with a median of $88. In some Forest Service Districts, collection by private contract was less expensive than collection by District forces; in other Districts, the reverse was true. Although the amount paid private contractors was influenced by many factors, competing employment opportunities appeared most important. Study teams found no established methods for evaluating the relative economic merits of the two systems. Forest Service solid waste collection crews were usually composed of two or three men. Long travel distances consumed many man hours, making route miles a costly item.

The following conclusions were drawn from the study:

1. *The solid waste generated in a recreation area can be related to the visitor use the area receives.*
2. *Recreational solid waste generation rates could not be shown to vary regionally or with the level of campground development.**
3. *Few Forest Service Districts operated specially adapted equipment for solid waste collection. Most relied on equipment used for other tasks.*
4. *Few Forest Service Districts used any equipment for solid waste disposal even when it was available.*
5. *In some Forest Service areas, private contract collectors could collect the solid wastes at the most reasonable cost; in other areas, District collection crews provided the service at costs far below contract bids.*
6. *Solid waste containers in Forest Service recreation areas are generally well designed and maintained. Plastic container liners aid both container sanitation and collection efficiency.*
7. *The distance from the Forest Service recreation area to the disposal site and the intensity of recreation use in the area had the most influence on the cost of solid waste collection.*
8. *All Forest Service land disposal sites encountered during the study were de facto dumps, not operated to local, State, or Federal standards.*

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*Level of development denotes the degree to which the area has been improved for the convenience of the recreator (See Appendix I).

TABLE 1

WASTE GENERATION RATES FOR RECREATION SITES

Recreation site	Average rate of waste generation 90 percent confidence interval
Campgrounds (lb/camper day)	1.26 ± 0.08
Campgrounds (lb/visitor day)	0.92 ± 0.06
Family picnic area (lb/picnicker)	0.93 ± 0.16
Group picnic area (lb/picnicker)	1.16 ± 0.26
Organization camps (lb/occupant day)	1.81 ± 0.39
Job Corps Civilian Conservation Corps Camps	
Kitchen waste (lb/corpsman day)	2.44 ± 0.63
Administrative and dormitory waste (lb/corpsman day)	0.70 ± 0.66
Resort areas	
Rented cabins (with kitchens) (lb/occupant day)	1.46 ± 0.31
Lodge rooms (without kitchens) (lb/occupant day)	0.59 ± 0.64
Restaurants (lb/meal served)	0.71 ± 0.40
Overnight lodges in winter sports areas (wastes from all facilities) (lb/visitor day)	1.87 ± 0.26
Day lodge in winter sports areas (lb/visitor day)	2.92 ± 0.61
Recreation residences (lb/occupant day)	2.13 ± 0.54
Observation sites (lb/incoming axle)	0.05 ± 0.03
Visitor centers (lb/visitor)	0.02 ± 0.008
Swimming beaches (lb/swimmer)	0.04 ± 0.01
Concession stands (lb/patron)	0.14 (1 site)
Administrative residences (lb/occupant day)	1.37 ± 0.35

RECOMMENDATIONS

1. Forest Service compliance with Executive Order 11282 should develop in three stages: (1) Open burning must be discontinued. (2) Individual Forest Service Districts must create small sanitary landfills for recreation and administrative solid wastes. (3) The Districts should then use these sanitary landfills as models and convince small communities using District land to adopt similar techniques. The Forest Service should insist on model operation of all solid waste disposal sites permitted on its land.

2. Individual Forest Service Districts should use equipment they already own to operate small sanitary landfills.

3. The Forest Service San Dimas Equipment Development Center should develop methods, equipment, and equipment modifications that will make sanitary landfills practical in Districts that have no readily usable landfill equipment.

4. Limiting collection to twice per week and increasing the storage capacity to hold accumulated wastes can reduce solid waste collection costs in some Forest Service Districts.

5. Forest Service District solid waste collection crews are often larger than justified, and many should be reduced in size. One man can usually service even the largest recreation area for the least overall cost.

INTRODUCTION

The Forest Service has been aware of the growing solid waste problem in recreation areas for some time. In 1967, the Forest Service, through its Equipment Development Center in San Dimas, California, completed a study of a mobile incinerator. Although the results of the 1967 study provided a good evaluation of the mobile incinerator, the Equipment Development Center did not have sufficient data to evaluate the costs of existing, competing collection and disposal systems.

The problems involved in gaining this background information prompted the Equipment Development Center to request that the Bureau of Solid Waste Management conduct a study to establish waste generation rates for major recreation activities and determine the costs of solid waste handling in representative Districts.

The project was funded separately by each agency. Both the Bureau of Solid Waste Management personnel and San Dimas Equipment Development Center personnel participated in field studies. Personnel of the Ranger Districts visited contributed valuable time and equipment in assisting the study teams.

A review of the literature revealed that data on the quantities of waste generated from recreation activities and on the cost of waste collection in those areas were unavailable from published sources. The conclusion was reached that a special study would have to be conducted to gather the needed information.

Weaver's authoritative study of solid waste management in recreation areas,[1] which was conducted in 1954, is inapplicable to the type and composition of solid waste generated today. New techniques have outmoded some practices- -the use of plastic container liners has eliminated the need for frequent can cleaning, the attendant collection practices and cleaning facilities, as well as increased the efficiency of collectors. The life style of campers has changed- -camping hardware and food packaging have possibly changed waste generation rates and composition. At the time of Weaver's report, there were no Federal efforts to control pollution or to encourage the standards for disposal that now apply to all Federal installations.

PROCEDURES

Site Selection

The study sites were chosen for the Bureau of Solid Waste Management by the Forest Service and were locations that represented various elevations and climatological conditions. The Weather Bureau's temperature–humidity index values for the 4 hottest months of the year were used to characterize the climate. This method gave a reasonable site distribution across the country (Figure 1). Other factors such as recreation area accessibility and proximity to urban areas were considered in selecting the sites.

Members of the staff of the Division of Technical Operations, Bureau of Solid Waste Management, and the staff of the San Dimas Equipment Development Center, Forest Service, scheduled and conducted 11 studies between June and September 1968 and a study of winter sport areas in March 1969 (Table 2). Details of each study are given (Appendix 2).

Individual Studies

Each site was studied for 4 days, Friday through Monday. The weekends were chosen to ensure heavy recreation use. The study team arrived on Thursday of the study week, discussed the study with District personnel, and collected wastes from the study area to ensure that wastes collected during the study period would be generated during that period.

The study on the Wayne–Hoosier National Forest in Ohio was extended to observe variations in the waste generation rates over a 3–wk period and to gather data from picnic areas from which visitor–use figures could be easily obtained.

Many Forest Service engineers from regional water and sanitation activities participated in the studies. Each District furnished a truck, driver, and platform scales.

The study team collected solid wastes from recreation areas on each day of the study. The wastes were weighed and sorted into three categories: food wastes, other combustibles, and noncombustibles. The waste quantities produced by each recreation activity were correlated to the use the area had received during a 1–day period of waste accumulation.

Measuring Recreation Use

Measuring recreation use was a persistent and difficult problem. The standard measure of Forest Service recreation use is the "visitor day." A visitor day is 12–hr use of a recreation facility by one person, or use by many persons whose aggregate time in an activity equals 12 hr.

The techniques Forest Service recreation personnel use to estimate visitor days vary from Forest to Forest. One of the most reliable is the double sample technique. On 12 randomly selected days during the recreation season, District personnel count the visitor use each activity receives while also counting some other variable such as axles on vehicles entering and leaving the area or the gallons of water consumed. A functional relationship between the two counts yields a formula to estimate visitor use (in visitor days) from more easily obtained counts of axles or gallons of water. Each formula derived is unique, and although its use is limited to the area where it was empirically derived, it yields statistically eliable use estimates.

In another technique, locally convenient measures of use were counted such as the number of swimmers on a beach or the number of campsites occupied. At the end of the season these counts were converted to visitor days by using subjective conversion factors.

At other Forests, personnel merely relate the current year's use to that previously reported without making an actual count.

Although these methods of use measure were adequate for normal Forest Service reporting, none was very accurate over short time intervals such as the 1 or 4 days used in the study. Therefore, the study teams estimated use at most study sites independently of the Forest Service. Counts by compliance checkers or periodically counting the people using the site are used for this report. Measuring use in intermittent activities such as boating and picnicking was often impossible, and double sampling, where it existed, proved unreliable for verifying estimates.

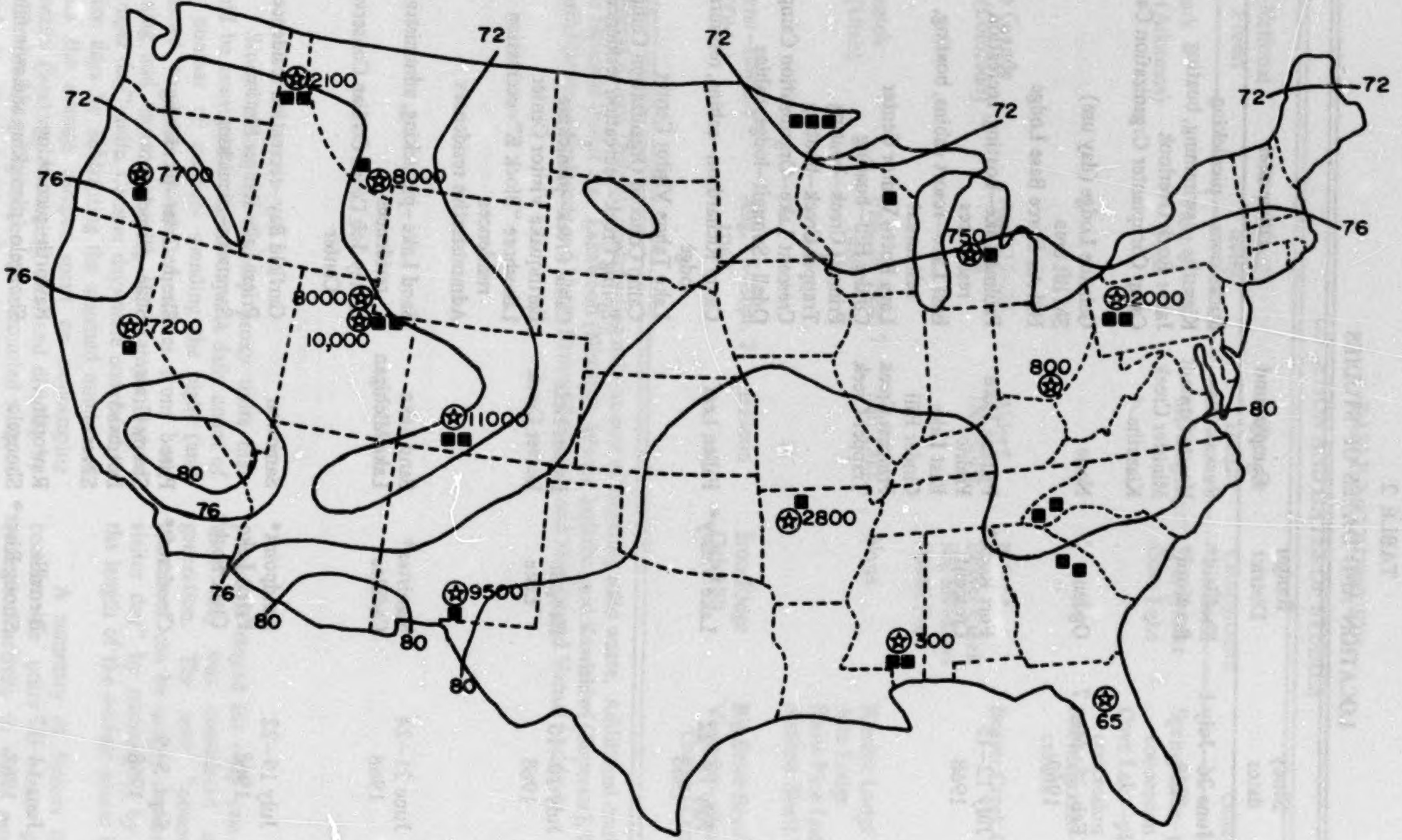
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Figure 1. Location of Study Sites. The contours represent locations where the daily temperature–humidity index values shown are equaled or exceeded 10 percent of the time during the 4 hottest months of the year. ✪ 2,500 indicates a selected site and its elevation; ■ represents a district surveyed for solid waste handling cost.

TABLE 2

LOCATION AND DATES OF STUDIES

National Forest	Study dates	Ranger District	Campground	Other sites
Allegheny (Pennsylvania)	June 26–July 1 1968	Sheffield* Bradford*	Buckaloons Hearts Content Minister Creek Kiasutha	Buckaloons – picnicking Kiasutha – swimming, boating Jakes Rock Overlook Camp Cornplanter Organization Camp
Cache (Utah)	Feb. 28–Mar. 7 1969	Ogden	None	Gelande Lodge (day use) Ski lift area Hill Air Force Base Lodge
Deschutes (Oregon)	July 12–15 1968	Fort Rock* Crescent	Paulina Lake Prairie East Lake Cinder Hill Princess Creek Trapper Creek	Paulina Lake–boating, recreation residences East Lake–resort cabins, boating, restaurant Lava Butte Visitor Center Cinder Hill–boating Princess Creek–boating Trapper Creek–boating Crescent Lake–Organization Camp Odell–Summit–lodge, cabins
Eldorado (California)	July 19–22 1968	Lake Valley*	Fallen Leaf	Camp Richardson–cabins, restaurant, lodge Lake Tahoe Visitor Center Camp Concord Organization Camp Spring Creek–recreation residences
Gallatin (Montana)	July 10–15 1968	Hebgen Lake	Bakers Hole Beaver Creek	Cabin Creek–picnicking Earthquake Visitor Center Lakeshore "Block E"–recreation residences Administrative residences
Huron–Manistee (Michigan)	June 21–24 1968	Manistee* Cadillac	Sand Lake Lake Michigan	Sand Lake–picnicking, administrative residences Hoxey Job Corps Civilian Conservation Center
Kaniksu (Idaho)	July 19–22 1968	Sandpoint* Priest Lake Clark Fork*	Samowen	Garfield Bay–recreation residences Priest Lake Ranger Station Samowen–picnicking
Lincoln (New Mexico)	Sept. 5–9 1968	Cloudcroft*	Pine Sleepy Grass Deerhead Silver	Sleepy Grass–picnicking Slide–picnicking
National Forest of Mississippi	June 14–17 1968	Bienville Strong River*	Raworth Shongelo	Raworth–picnicking Shongelo–picnicking and swimming

TABLE 2 (CONTINUED)

LOCATION AND DATES OF STUDIES

National Forest	Study dates	Ranger District	Campground	Other sites
Ozark (Arkansas)	June 21–24 1968	Mt. Magazine*	Spring Lake Cove Lake	Spring Lake–picnicking, swimming, concession Cove Lake–picnicking, swimming, concession Mt. Magazine–picnicking, lodge, cabins
Rio Grande (Colorado)	Aug. 23–26 1968	Alder* Del Norte	Palisade Beaver Creek Big Meadows South Fork	Beaver Creek Organization Camp
Wasatch (Utah)	Feb. 28–Mar. 7 1969	Salt Lake	None	Rustler Lodge Alta Lodge Snow Pine Lodge (day use) Shallow Shaft Tavern
Wayne–Hoosier (Ohio)	Aug. 13–Sept. 2 1968	Ironton	Iron Ridge Oak Hill	Big Bend Beach–concession Vesuvius–picnicking, Job Corps Civilian Conservation Center

* Forest Ranger Districts contributing data on cost of handling solid waste. Additional contributing Districts and their National Forest are: Lakewood (Nicolet); Aurora, Isabella, and Kawishiwi (Superior); Wayah and Pisgah (North Carolina); Redlands and Uncle Remus (Georgia); and Manilla and Vernal (Ashley).

Study teams did develop proxy units that could be converted to visitor days. A daily count of the number of campers spending the night (and assumed to have contributed wastes from both evening and morning meals), for example, led to "camper day" units. Camper days were converted to visitor days by subtracting the assumed number of hours the average camper spent on noncamping activities (boating, swimming, etc.) and dividing by 12. The number of picnickers was counted without regard to their length of stay. Because most picnickers stayed for only one meal, the length of their stay was considered irrelevant to waste generation. The unit "pounds of waste per picnicker" can be simply converted to "pounds per visitor day" by multiplying by 12 and dividing by the length of the average picnic in hours.

A summary of factors that can be used to convert the units of waste generation for each recreation activity to waste generation in terms of visitor days is given (Table 3).

TABLE 3

UNITS OF WASTE GENERATION AND METHODS OF CONVERSION

Recreation site	Unit expressing waste generation	Multiplier factors used to express waste generation in terms of visitor days
Campgrounds	pounds/visitor day	1
Campgrounds	pounds/camper day	12 ÷ (hours average camper spends in camp daily)
Picnic area	pounds/picnicker	12 ÷ (length of average picnic, in hours)
Organization camps	pounds/occupant day	1/2
Cabins	pounds/occupant day	12 ÷ (hours average guest spends at his cabin daily)
Observation sites	pounds/incoming axle	12 x (number of axles/vehicle) ÷ (the average stay in hours x the average number of people/vehicle)
Visitor centers	pounds/visitor	12 ÷ (length of the average visitor's stay, in hours)
Swimming beaches	pounds/swimmer	12 ÷ (length of the average swimmer's stay, in hours)
Boat launching areas	pounds/boat	12 x (average number of persons per boat) ÷ (average length of boat use, in hours)

Note: To convert 1.26 lb/camper day to lb/visitor day:

$$\text{lb/visitor day} = (1.26\ \text{lb/camper day}) \times \frac{12}{\text{(16.4 hr average camper spends in camp daily)}} = 0.92$$

Obtaining Cost Information

Questionnaires to discover the costs of handling recreational solid waste were distributed to representatives from 22 Ranger Districts (Table 1). They were asked to describe the costs of manpower, supplies, and equipment for both collection and disposal operations. Each interview was recorded on the cost questionnaire form (Appendix 5). Costs of solid waste handling for each District were correlated with the recreation use regularly recorded in the Forest Service Recreation Information Management (RIM) system.

RESULTS AND DISCUSSION

Rates of Waste Generation

Campgrounds. The average rate of solid waste generated at campgrounds was 0.92 lb per visitor day; the standard deviation was 0.08, or 9 percent of the mean. The frequency and cumulative distributions of visitor–day averages of the waste generation rate for 31 campgrounds were determined (Figures 2 and 3). From these figures, the waste generation rate that is exceeded on only a certain fraction of occasions can be selected. This curve is useful in determining the size of collection and disposal facilities to handle waste generation rates occurring, for instance, 90 percent of the time.

Camping waste generation rates can also be described in terms of the previously described "camper day." The frequency and cumulative distributions of the camper–day averages of this waste generation rate for 31 campgrounds on each of the study days have also been charted (Figures 4 and 5). The average generation rate was 1.26 lb per camper day; the standard deviation was 0.10, or 8 percent of the mean. Waste generation expressed in terms of camper days is most useful in estimating quantities of waste that accumulate over short periods because camper days are easily related to campground capacity.

Although waste composition from campgrounds varied greatly, the average composition of the waste was: food wastes, 37 percent; other combustibles, 30 percent; noncombustibles, 33 percent. When the composition of campground wastes is compared with typical residential waste[2] (Figure 6), it is apparent that campers generated a higher percentage of food wastes than that found in residential areas. Campers generated less other combustible waste, partly because they did not receive newspapers or mail and because they often burned much of their waste in camp fireplaces. The amount of noncombustibles was higher in camps than in homes primarily because of the number of convenient, disposable bottles and cans used in camping.

Variation in Solid Waste Generation Rate from Campgrounds. There was speculation, at the inception of the study, that amounts and composition of solid waste generated in recreation areas might vary from region to region. Campgrounds were studied as an indicator of this variation because they contribute the largest fraction of most District's solid wastes and because camping was the only activity contributing enough samples to give statistical reliability to the conclusions drawn from the data.

The data were evaluated (Appendix 3), and analyses sought to detect the existence of statistical differences between total waste generation rates in 23 campgrounds. Waste generation rates were also compared for the three types of waste composition (food wastes, other combustible wastes, and noncombustible wastes). Campgrounds were also grouped by level of development (see Appendix 1) and by type of use: those that received overnight use predominantly and those that were destinations, where the campers visited for longer periods.

An analysis was performed to detect statistical differences between the total solid waste generation rates in different campgrounds. The conclusion reached was that there are no statistically significant differences among the average total waste generation rates in the campgrounds studied.

In considering the total waste for all 23 campgrounds, the day on which the wastes were generated (Thursday, Friday, Saturday, or Sunday) was not a significant factor. Day of generation was significant, however, when destination campgrounds developed to level four were considered. This significance was strong enough to make day of generation significant when both level three and four destination campgrounds were considered together, but not when level three destination and overnight campgrounds were considered alone.

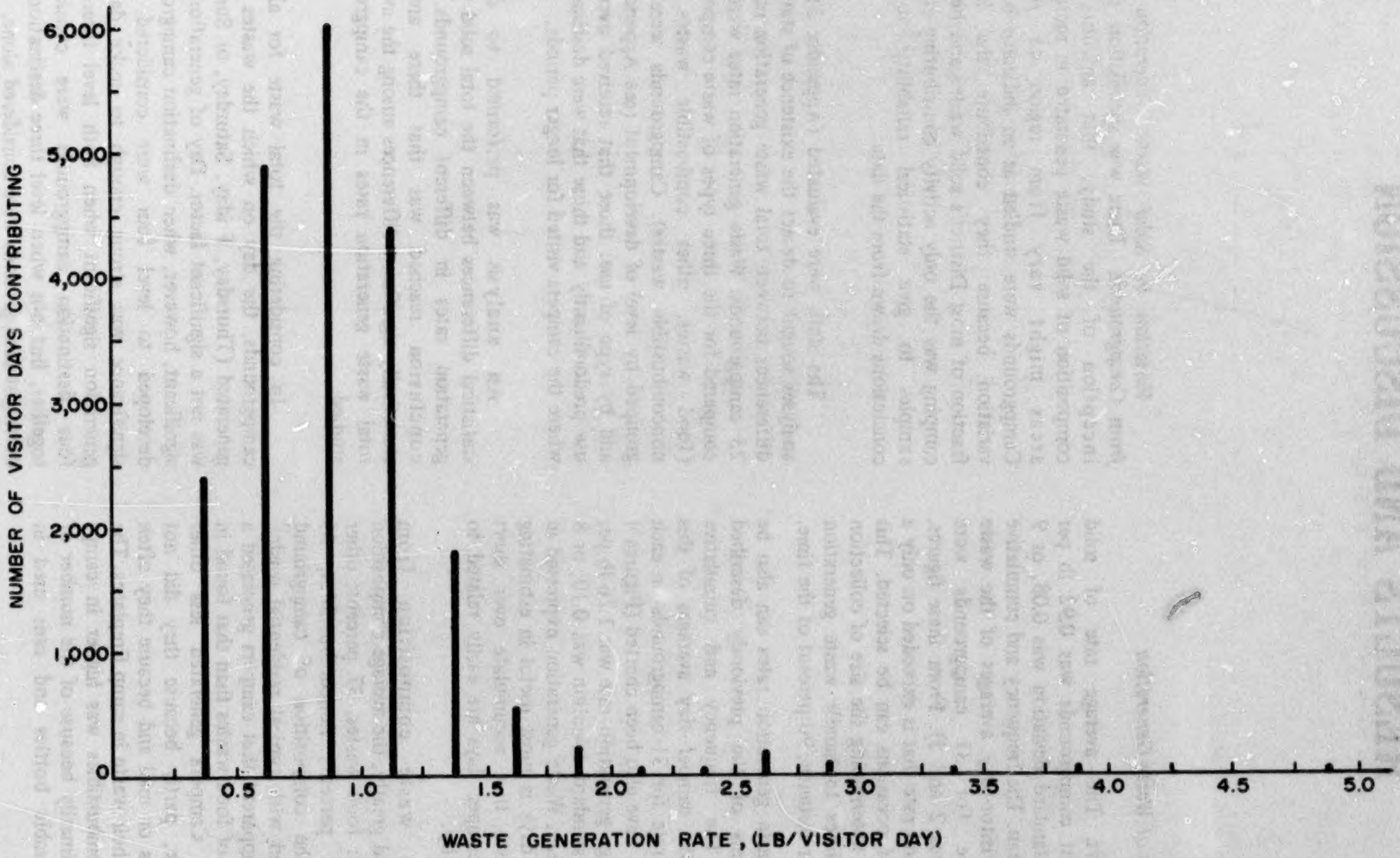

Figure 2. Frequency distribution of the waste generation rate for 31 campgrounds, pounds per visitor day.

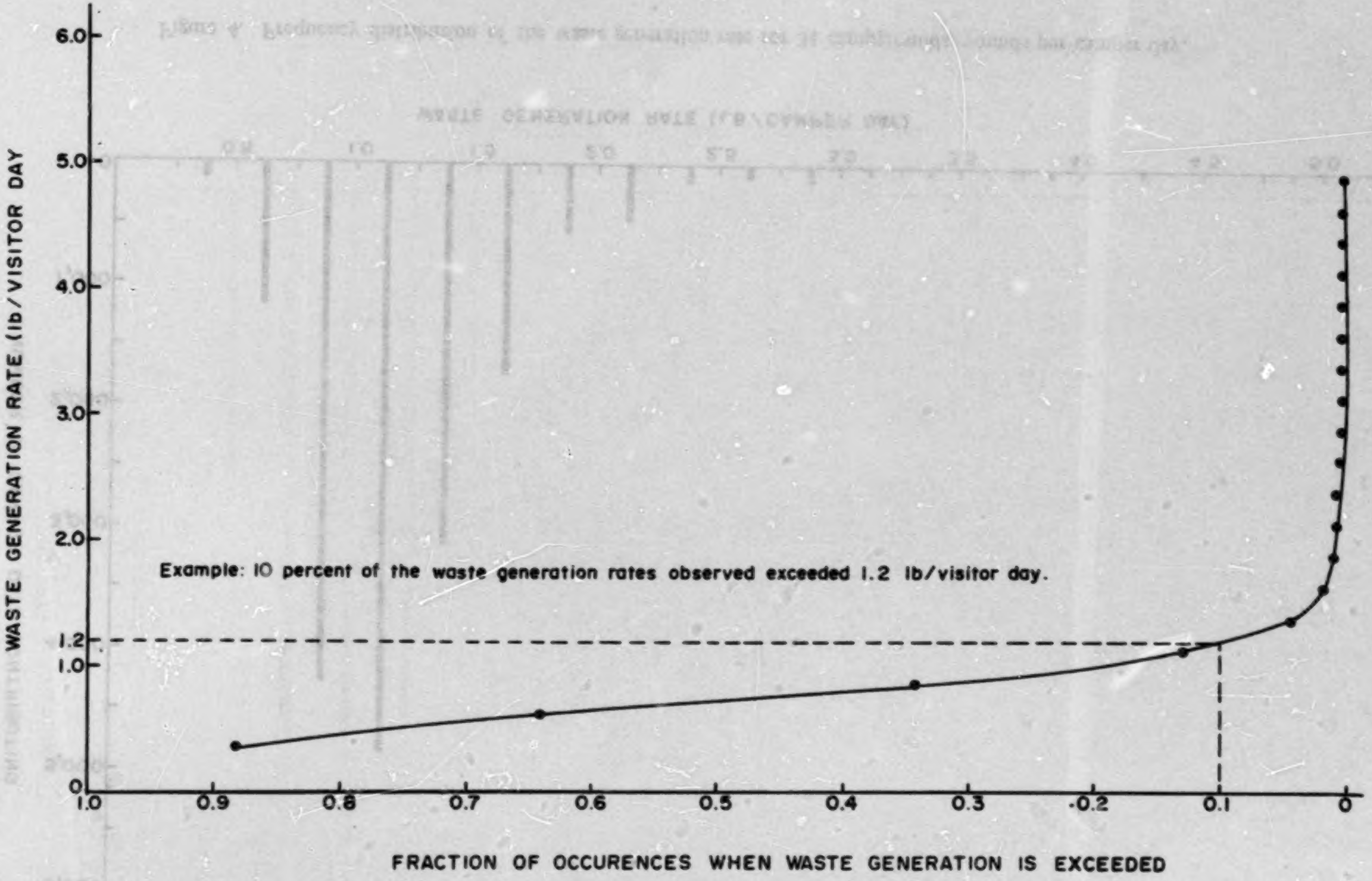

Figure 3. Cumulative distribution of the waste generation rate for 31 campgrounds, pounds per visitor day.

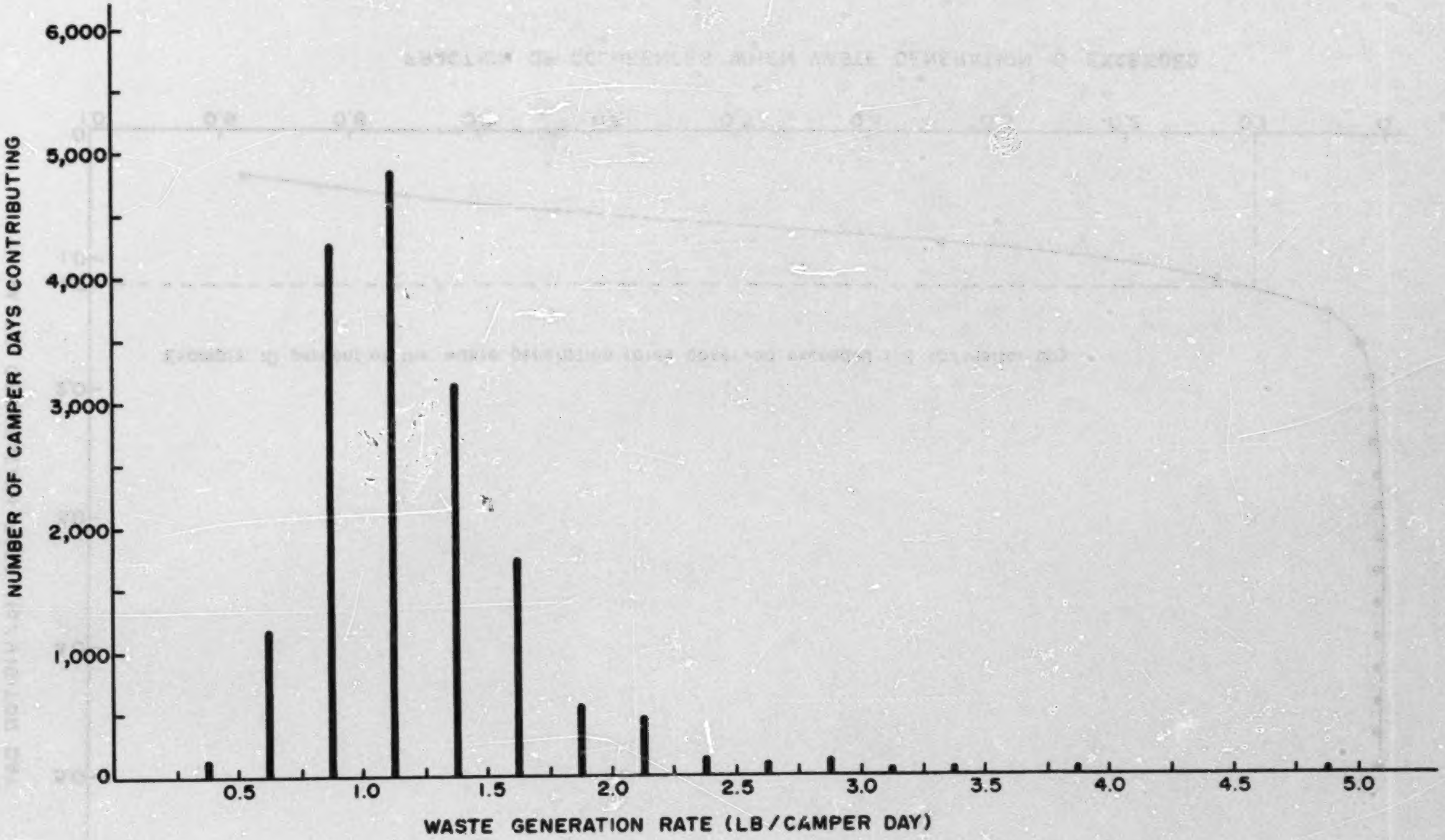

Figure 4. Frequency distribution of the waste generation rate for 31 campgrounds, pounds per camper day.

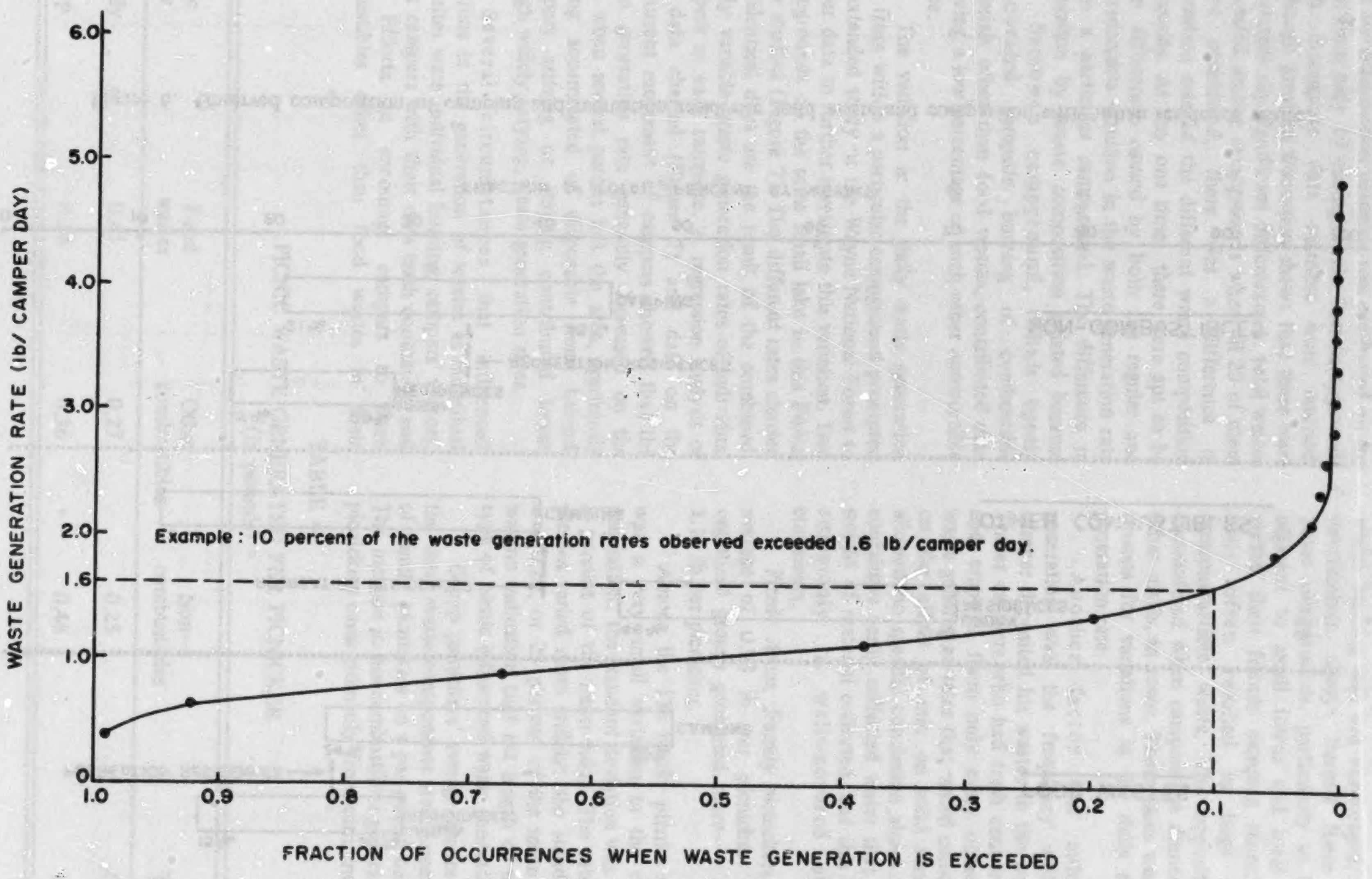

Figure 5. Cumulative distribution of the waste generation rate for 31 campgrounds, pounds per camper day.

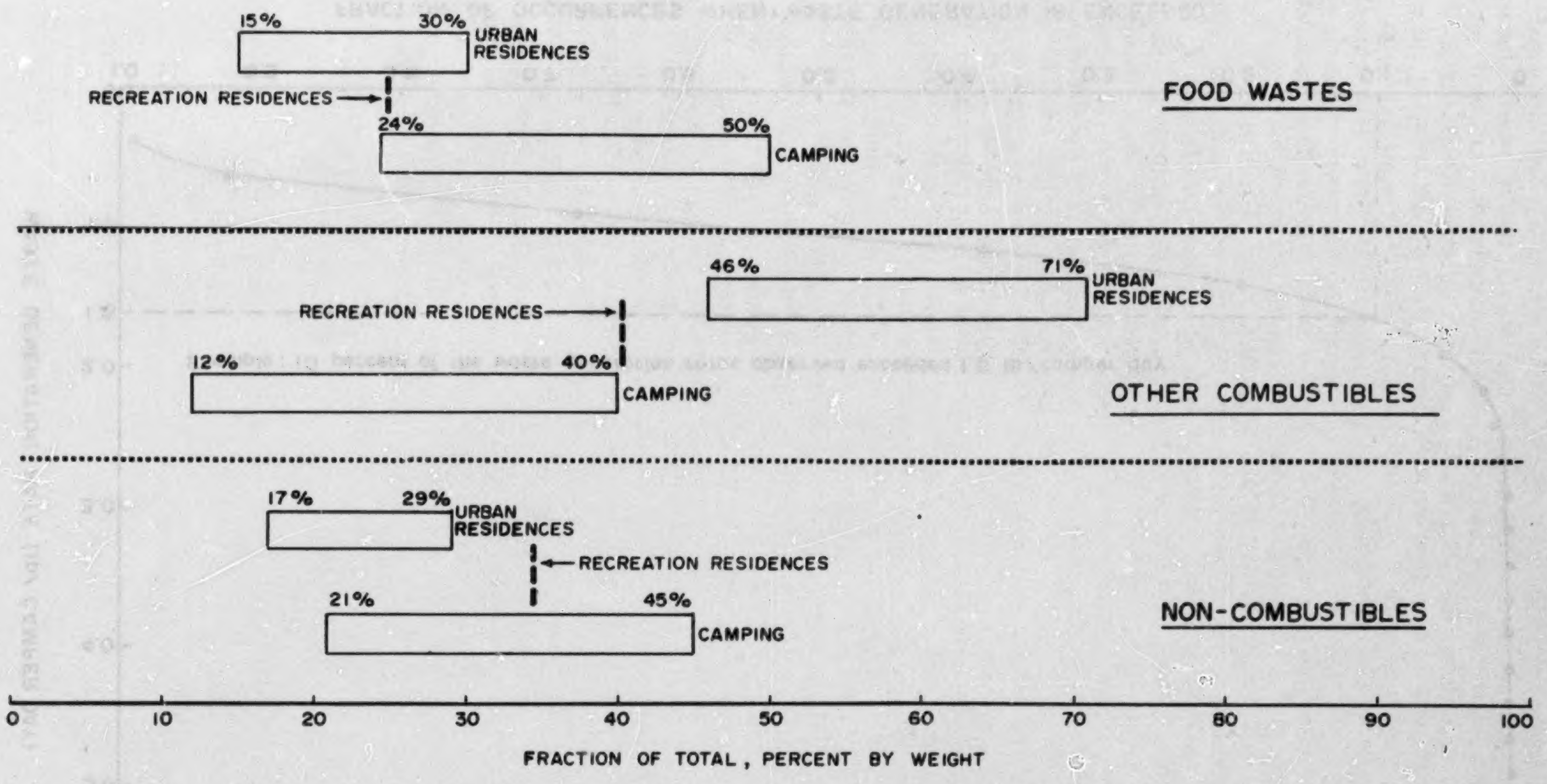

Figure 6. Observed composition of camping and recreation residence solid waste and comparison with urban residence values.

Analysis of variance of solid waste generation rate by composition category was conducted on the data from only 19 campgrounds; four campgrounds with incomplete data matrices were omitted. Although previous discussion shows that there were no statistically significant differences in total wastes generated among campgrounds when all 23 of them were considered, there was a difference in generation rate of the different waste composition categories. At any one time, there were apt to be large differences caused by both the regular and unpredictable variation in the waste generation rate from a particular campground. The difference in generation by waste composition existed because the Samowen campground, which openly encouraged campsite burning of combustible materials other than food wastes, contributed data showing a low percentage of such other combustible waste.

The variation in the daily waste generation rate from within a particular campground prompted an extended study at the Wayne National Forest to gather data to further investigate this variation. Two campgrounds on the same small lake in this Forest were studied (Figure 7). The different rates charted for identical days are the result of the combined, highly variable waste generation rates of individual campers at each campsite. A regression analysis of the data charted (Figure 7) and data on the concurrent movement of campers showed that the waste generation rate generally increased on the days when several parties left the area, apparently leaving accumulated or disposable items behind. Campers arriving or staying contributed lower, though widely varying, waste generation rates.

Several circumstances that influenced variations in the generation of wastes at individual campsites were individual burning, campers' visitors, trailer campers with their own trash containers, and rain. Efforts to encourage campers to burn combustibles other than food wastes in their fireplace had a noticeable effect. In campgrounds where burning was not encouraged, some campers, nevertheless, always burned these combustibles. Some campgrounds, particularly in the East, were adjacent to small towns and local people often visited their friends camping there. An evening's visit often resulted in large quantities of noncombustible waste. The opposite effect was encountered when campers ate dinner, and perhaps other meals, in town. These cases were accepted as reasons for variations in the daily camping waste generation rate.

Another factor that influenced waste generation was the frequency with which the camper deposited his wastes in the waste container. Trailer campers who had trash cans in their trailers and emptied them only every other day created waste generation rates that varied considerably. Data on the effect of rain on solid waste generation allowed no specific conclusion about it. Subsurface containers easily collected water that increased the weight of material collected, but this did not occur commonly in well–covered above–ground containers.

Picnic Areas. Family picnickers generated an average of 0.93 lb per picnicker. Picnickers in organized groups generated more– – an average of 1.16 lb per picnicker.

Among the 136 family picnics studied, there was a very small variation in the rate of waste generation: the standard deviation was only 0.07, or 8 percent of the mean value. The rate from group picnics varied more widely: the standard deviation was 0.29, or 25 percent of the mean value. There was no indication that the length of time of either type of picnic influenced waste generation.

Group picnickers' average generation rates for the three waste components are compared with that of family picnickers on a per pound basis (Table 4). The increase in noncombustibles generated by group picnickers came primarily from cans and bottles.

TABLE 4

PICNIC WASTE GENERATED PER PICNICKER
(in pounds)

Picnic type	Food wastes	Other combustibles	Non–combustibles	Totals
Family	0.41	0.27	0.25	0.93
Group	0.34	0.36	0.46	1.16

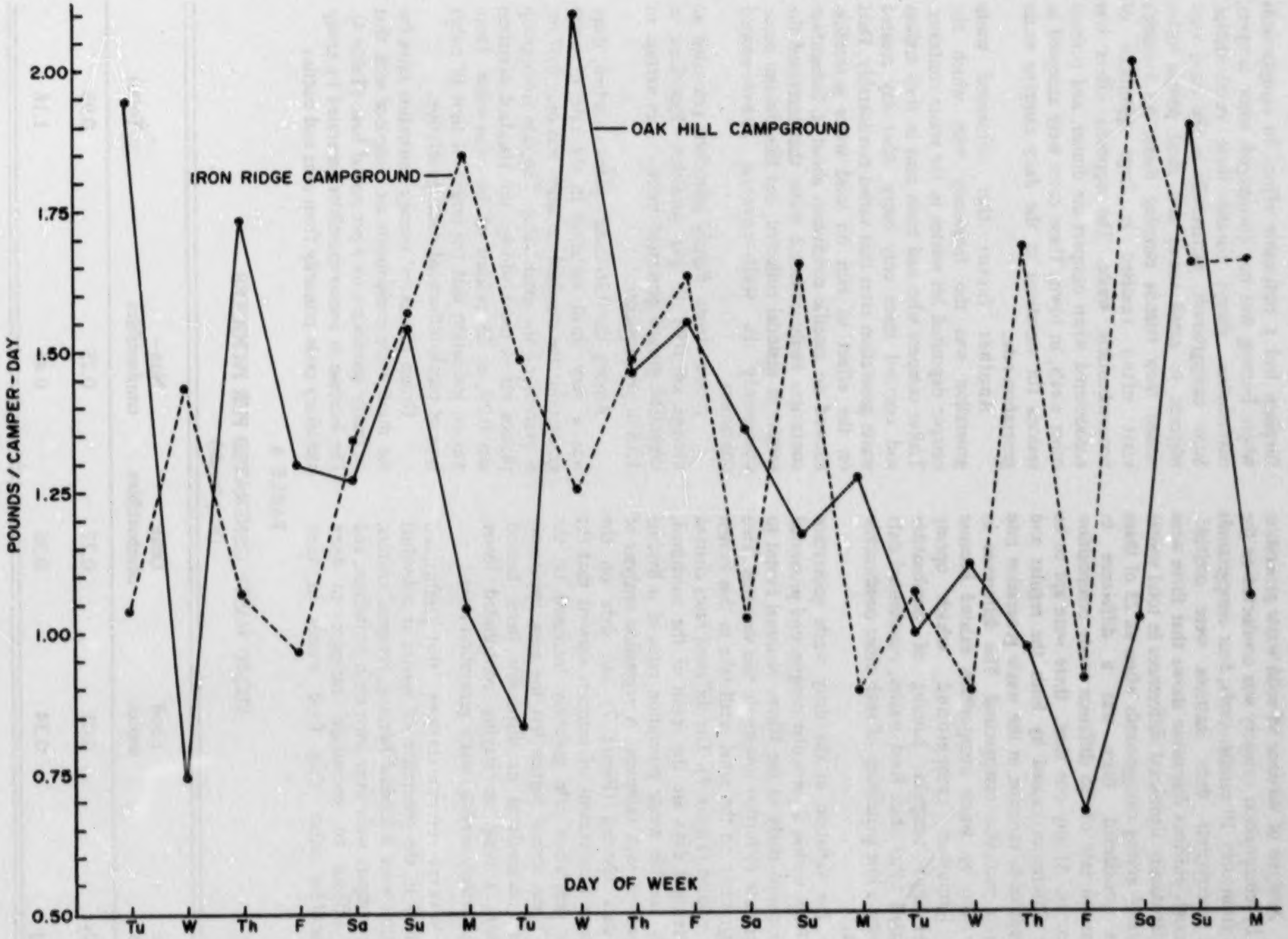

Figure 7. Variation in campground solid waste generation, Wayne–Hoosier National Forest.

Organization Camps. Scout, church, and city camps with permanent facilities on National Forest land are known as organization camps. There is no significant source of waste from these camps other than from the kitchen. Solid wastes were generated at an average rate of 1.81 lb per camp–occupant day or about 0.6 lb per occupant per meal served; the standard deviation was 0.31, or 17 percent of the mean.

The average generation rates varied in the four organization camps studied (Figure 8). Wastes from organization camps were primarily wet garbage and paper. Boxes and packaging material were frequently thrown out at the beginning of the week as shipments were unpacked. The composition of the average waste, by weight, was: food wastes, 59 percent; other combustibles, 18 percent; and noncombustibles, 23 percent.

Recreation Residences. These are defined as private homes located within a National Forest; they may be occupied on an intermittent or year–round basis. A total of 90 such recreation residences were sampled during the study. The average rate of solid waste generation was 2.13 lb per occupant day. The standard deviation was 0.44, or 21 percent of the mean. The composition of average wastes, by weight, was: food wastes, 24 percent; other combustibles, 41 percent; and noncombustibles, 35 percent.

Winter Sports Areas. Many winter sport sites are operated through permits on National Forest land. From a special study of two winter sport areas in Utah, information was gained on both waste composition and waste generation from three overnight lodges, two day lodges, a tavern, and ski lift base area. Wastes, primarily from rooms and kitchens of overnight lodges, were generated at an average rate of 1.87 lb per visitor day, with a standard deviation of 0.80, or 43 percent of the mean. The composition of the average waste, by weight, was: food wastes, 34 percent; other combustibles, 33 percent; and noncombustibles, 33 percent.

Wastes from all facilities in the day lodges averaged 2.92 lb per visitor day, with a standard deviation of 0.66, or 23 percent of the mean. The composition of the average waste, by weight, in day lodges was: food wastes, 17 percent; other combustibles, 59 percent; and noncombustibles, 24 percent.

Recreation Sites Generating Minor Quantities of Solid Wastes. Observation sites, visitor centers, and boating and swimming sites generate only minor quantities of waste, and little data were collected concerning them. Meaningful use figures to accompany the weight data were often difficult to obtain. At some of the isolated sites, accurate use counts were time consuming and impractical. The following solid waste generation rates are approximate (this shortcoming is not serious, however, since these activities only justify containers to prevent littering): observation sites, 0.05 lb per incoming axle; visitor centers, 0.02 lb per visitor; swimming sites, 0.04 lb per swimmer; boat ramps, 0.24 lb per boat; and concession stands, 0.14 lb per patron.

Administrative Sites. The administrative sites studied were: administrative residences, work centers, and a mess hall at a firefighters camp. Wastes were collected from staff residences at ranger

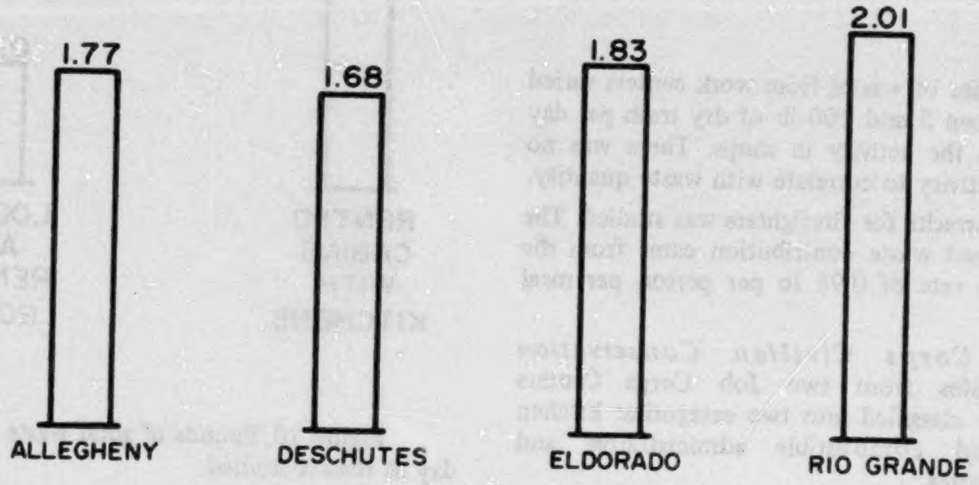

Figure 8. Pounds of solid waste per occupant day at four organization camps.

stations and at one Job Corps Civilian Conservation Center. The average waste generation rates were 1.37 lb per person per day from homes around ranger stations and 1.77 lb per person per day from the homes of the Job Corps Center staff.

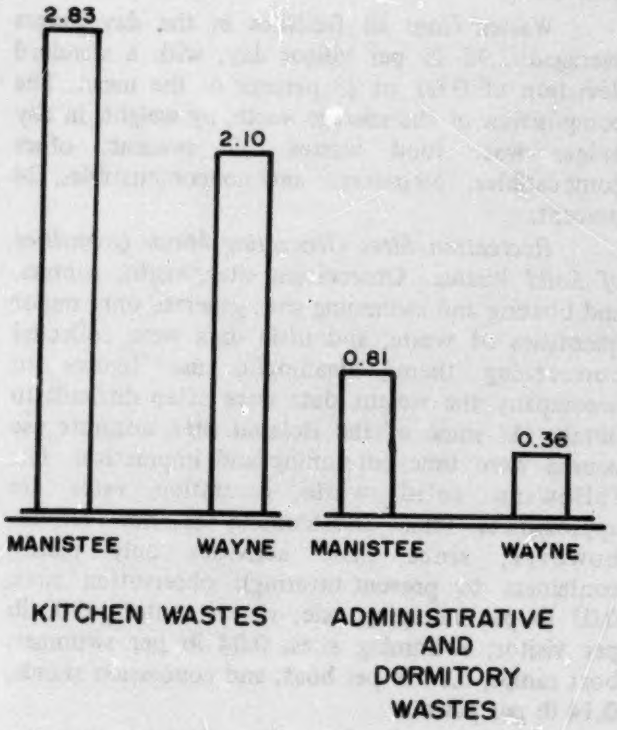

Figure 9. Pounds of solid waste per corpsman day at two Job Corps Civilian Conservation Centers.

Quantities of wastes from work centers varied greatly: between 5 and 100 lb of dry trash per day depending on the activity in shops. There was no measure of activity to correlate with waste quantity.

One barracks for firefighters was studied. The most significant waste contribution came from the kitchen, at a rate of 0.98 lb per person per meal served.

Job Corps Civilian Conservation Centers. Wastes from two Job Corps Centers studied were classified into two categories: kitchen wastes, and combustible administrative and dormitory wastes.

Kitchen wastes were produced in slightly greater quantities than in restaurants and organization camps. Waste generation is stated in terms of corpsman days. Because of the variable number of bagged lunches, one corpsman day was approximately three corpsman meals.

Average waste generation for one center was 2.83 lb of kitchen waste and 0.81 lb of administrative and dormitory waste per corpsman day. At the other center, 2.10 lb of kitchen waste and 0.36 lb of administrative and dormitory wastes per corpsman day were generated (Figure 9). The average amount of kitchen wastes for the two centers was 2.44 lb per corpsman day (or about 0.8 lb per meal served).

Resorts. The resorts studied contained restaurants, rented cabins with kitchens, and rented rooms without kitchens. Wastes at the restaurants studied were generated at a rate similar to the rate for kitchen wastes at Job Corps Centers and organization camps: 0.71 lb per meal served. In cabins, wastes were generated at an average rate of 1.46 lb per occupant day, with a standard deviation of 0.38, or 26 percent of the mean. In rented rooms, wastes were generated at an average rate of 0.59 lb per occupant day, with a standard deviation of 0.28, or 47 percent of the mean (Figure 10). Wastes from rooms without kitchens were primarily paper whereas wastes from cabins with kitchens also contained small amounts of food wastes.

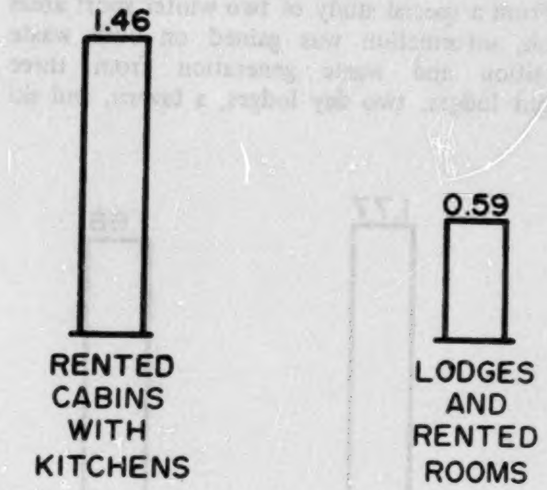

Figure 10. Pounds of solid waste per occupant day at resorts studied.

Value of Solid Waste Generation Rates. The solid waste generation rates established in this report allow Districts to predict the total amount of waste they will receive in a given week or season. This information can be used to estimate the size of storage facilities, collection vehicles, and sanitary landfill space needed in an area.

After estimating the volume of solid waste in storage containers, collection trucks, and enclosed transfer sheds, a density of 170 lb per cu yd* appears applicable in calculating the related weight values.

The density of solid wastes in sanitary landfills varies with the compaction imparted by the techniques and equipment used. There is most compaction when waste is spread and compacted in thin layers, not exceeding 2 ft in depth. The compaction imparted by various equipment types is not well documented, but for landfill design purposes, a density of 600 lb per cu yd is reasonable in small Forest Service sanitary landfills.

Small sanitary landfills for recreation and administrative wastes will contain about 40 percent cover material when completed because small quantities are frequently covered. Required sanitary landfill volume for each season would then be:

$$V = \frac{P}{0.6 \times 600} = \frac{P}{360}$$

where V is volume in cubic yards and P is waste in pounds.

Solid Waste Storage Practices

Because adequate solid waste storage is important to campground aesthetics, good storage facilities are expected. Except for solid waste storage capacity in overflow camping areas and the use of paper container liners in one district, solid waste storage in the Forest Service was found to be adequate.

Forest Service solid waste storage containers are generally well maintained. Although the study members encountered many different configurations of solid waste storage containers (Figure 11), most employed standard G.S.A. welded 32–gal cans with lids. Most cans had fastened–down lids, were designed to stay upright, and were on concrete pads. All above ground containers were reasonably water tight.

Districts generally provided adequate storage capacity. The only consistent exception to this was found in overflow camping areas. One campground that was frequently marauded by bears had elaborate "mail box" hoppers locked to each can to keep bears from feeding on garbage. The only can serving the overflow camping section of this same area, however, held only about one–third of the wastes deposited there daily. The rest of the waste, stacked around the can, was easy bait for bears.

The containers cost between $35, for the simple post and concrete pad, and $125, for the elaborate bearproof cans (Figure 11). Where improvements had been made on the basic can and post (lid fasteners, locks, etc.), the small increase in cost was believed justified; this study did not find otherwise.

Reasons for container placement were as varied as the container designs encountered. Where cans were placed beside the road under "garbage" signs, the conspicuous container supposedly discouraged littering by openly suggesting its use. Where cans were hidden underground beneath camouflaged green lids or where inconspicuous cans were used, the enhanced campground beauty was believed to discourage litter. Each of these unverified assumptions probably has merit. However, our observations suggest that the prominence of containers was not of prime importance in campground litter control.

When each campsite had its own container, the camper was more careful of litter than when the container was shared with neighbors. Shared containers were usually placed between campsites on ground that neither camper felt responsible for keeping clean. A personal can at the campsite openly exhibited the camper's housekeeping, however, and the site was usually well kept.

At picnic areas and other areas used intermittently, prominently displayed containers were absolutely necessary for litter control. The picnicker or hiker did not always feel the need to control his clutter at a site he was visiting for only a short time. Prominently displayed, densely spaced containers were the only answer in these areas.

Almost every District in the Forest Service used plastic can liners. The Districts surveyed spent between $22 and $1,460 on plastic liners, with a median of $200 per District each season.

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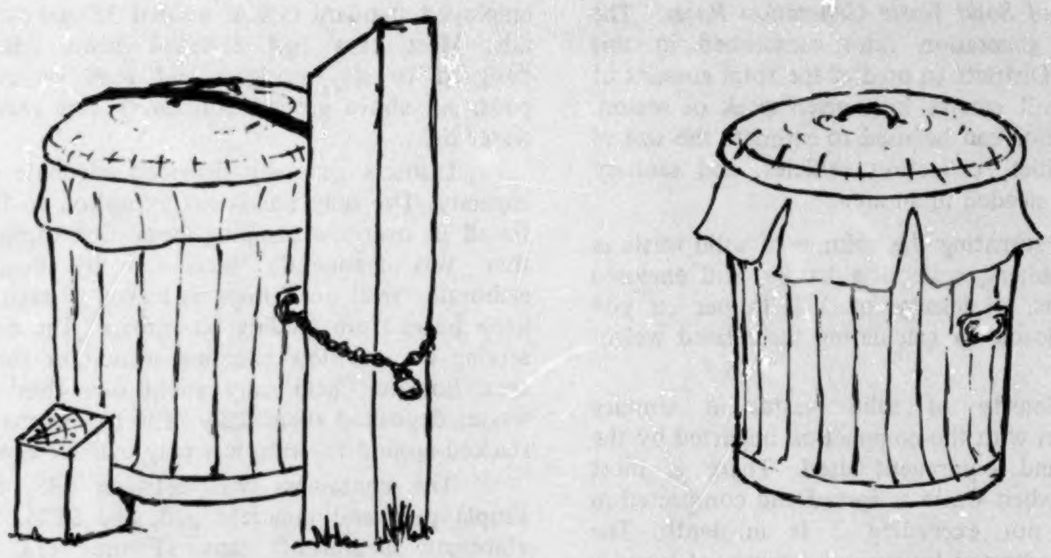
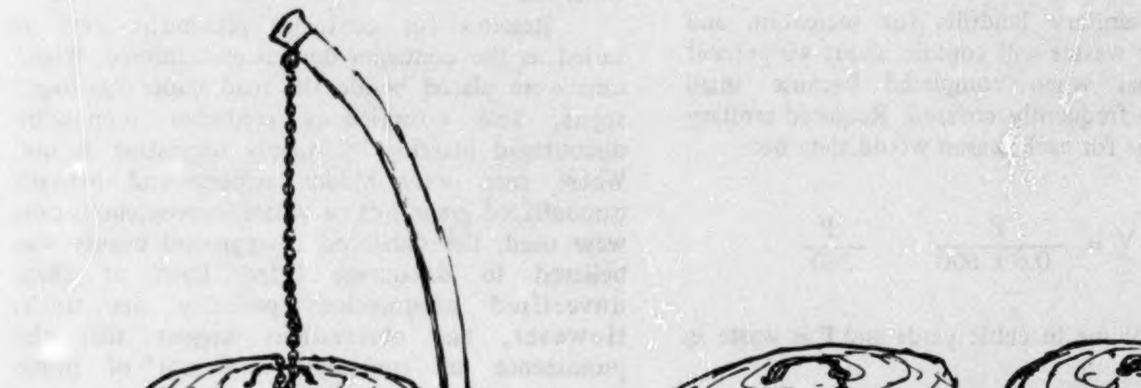
*Division of Technical Operations has estimated that 170 lb per cu yd is the average density of solid wastes as collected. This figure is based on past experience. Density was not regularly measured during the study.



Container held off the ground by posts. Lid held on by a rubber strap. Plastic liner in place.

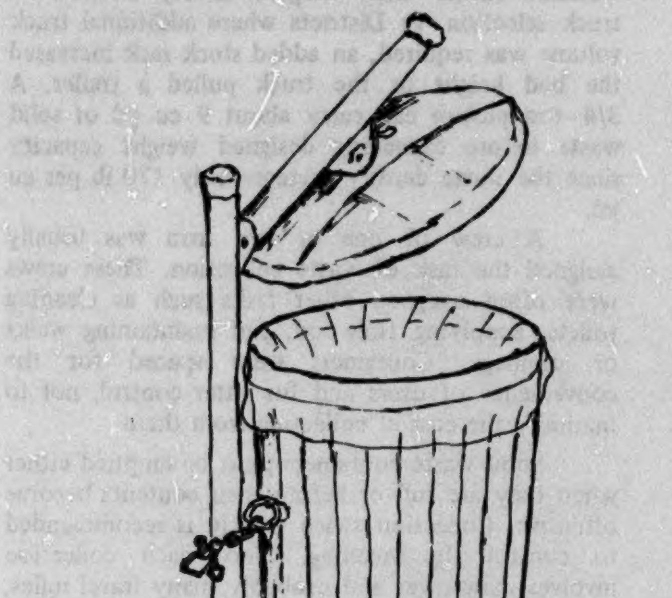
Paper container liner



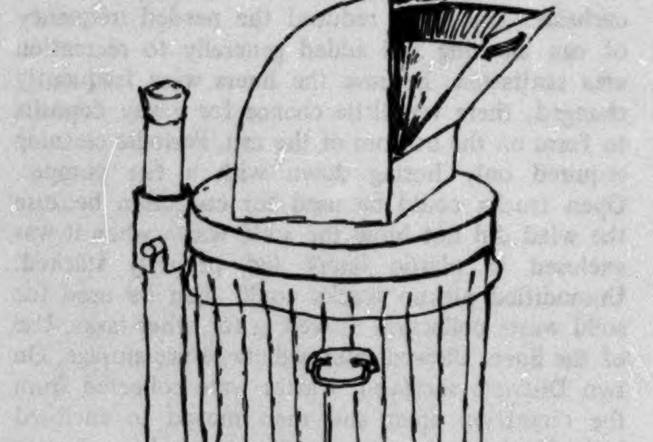
Container with lid attached to post by a chain

Pivoting bearproof containers

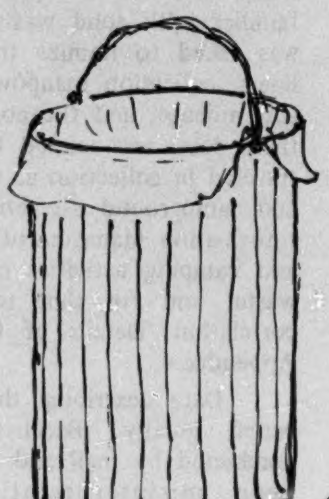
Figure 11. Types of solid waste containers observed.

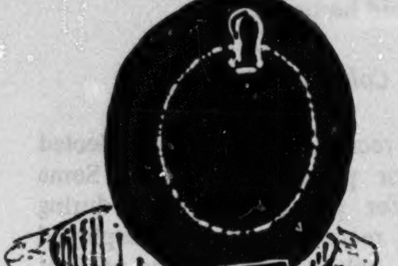


Container with lid attached to post



Bearproof "mail box" container





Subsurface container

Figure 11. (continued)

In the Forest Service Districts, plastic liners increased collection efficiency. A collector could empty several cans before returning to the truck. A two–man crew could work independently; one working with the truck, the other tying bags from the cans he emptied and then placing them at curbside. The liners reduced the needed frequency of can cleaning and added generally to recreation area sanitation. Because the liners were frequently changed, there was little chance for messy deposits to form on the bottom of the can. Periodic cleaning required only hosing down with a fire pumper. Open trucks could be used for collection because the wind did not blow the solid waste when it was enclosed in plastic liners and properly stacked. Unmodified pickup trucks could then be used for solid waste collection as well as for other tasks. Use of the liners allowed intermediate refuse storage. On two Districts surveyed, wastes were collected from the recreation areas and then moved to enclosed bins for later transfer to larger trucks going to disposal sites. The filled plastic liners, tied shut with twists, could easily await weekly collection.

Kraft paper can liners were encountered on one Forest. There were no apparent advantages to their use. Instead, when compared with plastic liners, they cost nearly three times as much, were brittle and easily torn, required more time to unfold and place in cans, and were not easily tied or twisted closed.

Solid waste storage by permittees in winter sport areas was often poorly conducted because of heavy snows and poor access. This can be serious because these facilities are often in protected watersheds. Operating standards specified in land use permits for these areas should receive immediate enforcement, and those that specify less than Federal standards should be rewritten.

Solid Waste Collection Practices

Solid wastes in recreation areas were collected by District forces or private contractors. Some Districts contracted for private collection during the season of heavy recreation use and deployed Forest Service crews only during seasons of light use. There was no evidence to suggest that one system was always less expensive or more efficient than the other. Attitudes toward private collection varied from District to District and were based on past experience with local contractors.

Forest Service and private collectors used open pickup or stakebed trucks most often. Volume, rather than weight, usually determined truck selection. In Districts where additional truck volume was required, an added stock rack increased the bed height or the truck pulled a trailer. A 3/4–ton pickup can carry about 9 cu yd of solid waste before exceeding designed weight capacity since the waste density averages only 170 lb per cu yd.

A crew of one or two men was usually assigned the task of waste collection. These crews were often assigned other tasks such as cleaning toilets, supplying firewood, and maintaining walks or drainage. Containers were spaced for the convenience of users and for litter control, not to minimize the cost of collecting from them.

Solid waste containers must be emptied either when they are full or before their contents become offensive. Collection twice weekly is recommended to control fly breeding. Since each collection involves manpower and probably many travel miles, collection more than twice weekly is unnecessarily expensive. Containers at campsites should be spaced between waste sources so they will be full twice each week, provided that the spacing provides adequate litter control.

Collection Cost Study

Cost information was obtained from 22 Districts in 15 Forests. The staff member most familiar with solid waste handling in the District was asked to itemize the seasonal cost of plastic liners, collection manpower, collection truck rental and mileage, and the cost of disposal. The sum of these costs was related to the seasonal route miles traveled in collection as well as seasonal picnic area and campground use retrieved from the Recreation Information Management (RIM) system. Picnicking and camping activities contributed the most solid waste, and for that reason, were used in the correlation. Details of the analysis are found in Appendix 4.

Data describing the economics of collection varied greatly. Because some interviews were conducted by mail and telephone, there may have been misinterpretations. District accounting techniques also made it awkward to retrieve the desired information. A third source of variation was the questionable reports of visitor use by some District Rangers to the RIM system.

Conclusions from the collection cost study data include: (1) Cost per estimated ton of solid waste collected and disposed of in each District ranged from $28 to $302, with a median of $88.

(2) The number of plastic liners used on each of 22 Districts was linearly related to the weight of solid waste collected in those Districts. (3) Collection route miles traveled was the variable most highly related to solid waste handling costs, followed by campground capacity and thousands of picnic visitor days.

An equation to describe this relationship was developed from a stepwise regression analysis:

$$C = 0.77\ RM + 1.13\ PAOT + 27.6\ PVD - 403$$

where:

C = Total solid waste handling cost for the time period considered, in dollars,

RM = Collection route miles traveled during the time period considered including distance to dispoal site,

PAOT = Capacity of the campgrounds in number of campers, and

PVD = Thousands of picnicker visitor–days incurred over the time period considered.

The precision of the equation is illustrated (Figure A4–1, Appendix 4).

Improving Solid Waste Collection

When solid waste containers in camping areas are spaced between two or three campsites, they require more frequent collection than when each site has its own container. Frequent collection, particularly in remote areas, adds to the total travel distance involved in collection and disposal. Supplying more containers reduces the needed collection frequency and the route miles traveled.

Using the average waste generation rate for one camper, 1.26 lb per camper day, and an average density (as collected) of 170 lb per cu yd, and a solid waste container reasonably full at 24 gal, each container will accommodate the wastes of 16 camper days. When five persons per campsite is assumed, one can, spaced between every three sites, will hold wastes accumulated in 1.1 days. This situation will require collection daily. If containers are spaced between each two sites, they will hold the wastes that accumulate every 1.7 days, and collection every 2 days will be adequate. A solid waste container at every site, however, will hold the wastes accumulated in 3.4 days and will require collection only twice a week.

An example will illustrate the economy of reduced collection frequency. A well–occupied campground of 48 campsites served by 16 containers will require collection six or seven times a week. If the campground is 15 miles from the work center, collection entails at least 180 miles of travel each week. If the campground were provided with 32 more cans, collection would be reduced to twice weekly. The District would spend about $50 for each of 32 new containers, or $1,600. Distributed over 5 years, this cost amounts to only $320 a year. At least 120 collection route miles would be saved each week by decreasing the collection frequency. Over a 12–wk recreation season, this would amount to 1,440 miles. By applying the formula for total solid waste handling costs (Appendix 4), a reduction of 1,440 route miles would mean a saving of $1,110, or a net saving of $790 each season after subtracting the cost of cans. The saving resulting from less frequent collection far outweighs the cost.

As previously mentioned, two men were usually assigned the job of waste collection. In many cases this was an uneconomic use of manpower. Although the use of two men ensures the quickest collection, the long travel times to and between recreation areas offset the contribution of a second collector. No private collectors observed employed two men. The value of employing a second collector can be analyzed graphically (Figure 12) given the travel time (to and from the recreation area) and the collection time in the area. The decrease in collection time necessary to economically justify the travel of a second collector is illustrated. This assumes both collectors are paid at the same rate; a second collector paid more than the first collector will have to contribute even more toward reducing collection time.

The use of transfer sheds to reduce the frequency of haul from recreation areas to disposal sites may be justified in Districts where the seasonal cost of manpower, supplies, and equipment used in the transfer–shed storage, collection, and disposal system is lower than it could be with the use of any other system. Modifying a collection system with an innovation such as a transfer shed may reduce seasonal cost but, at the same time, not reduce it as much as an entirely new system.

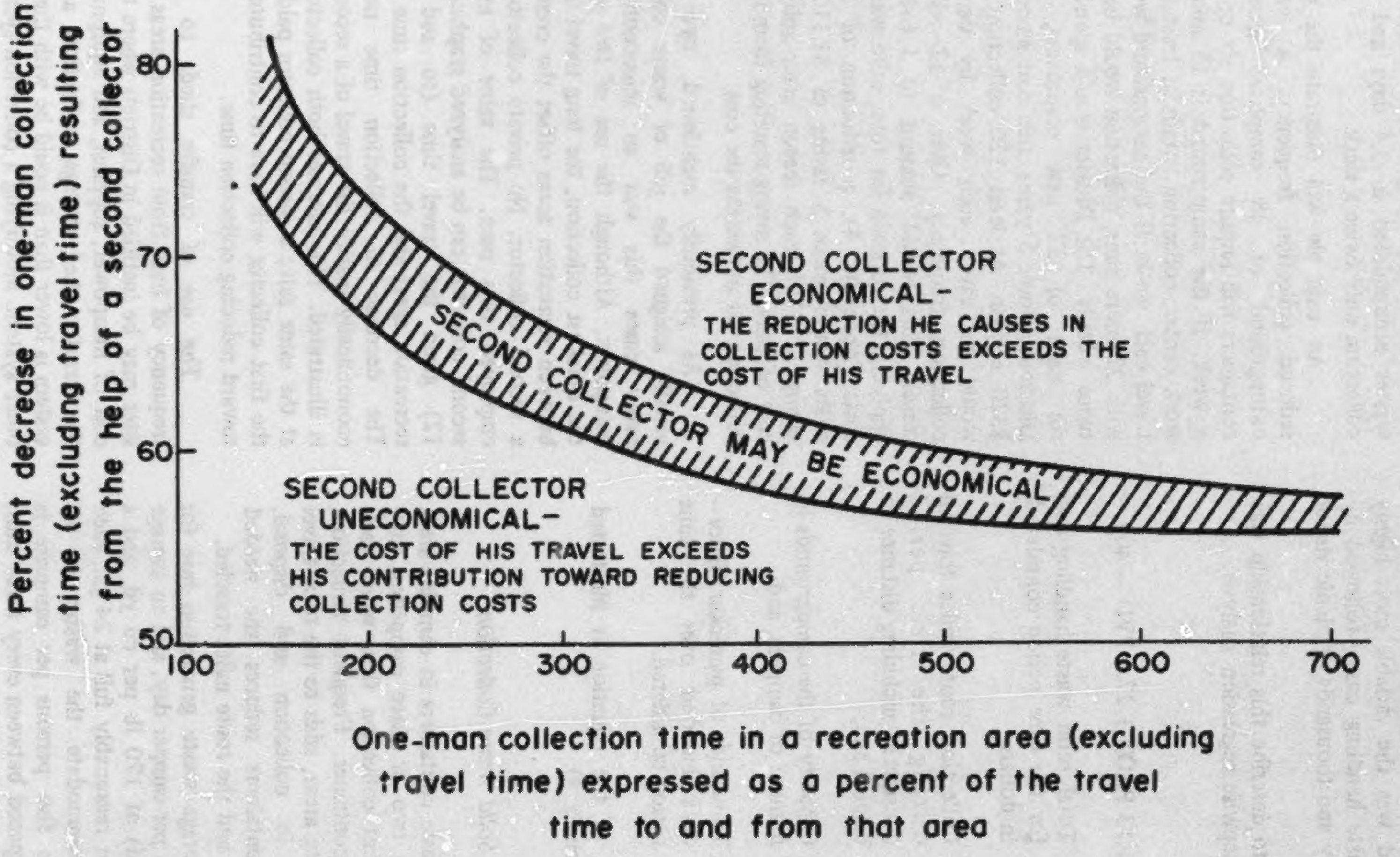


Figure 12. Economic effect of employing a second collector.

Solid Waste Disposal

The economic questionnaires submitted to 22 Districts indicated that an average of less than 4 percent of their solid waste handling money financed final disposal. About one–half of the Districts reported no expenditure for disposal at all. Nearly every Forest Service District has a different approach toward disposal of solid wastes because nearly every District is affected by different local circumstances.

Many Districts use community dumps operating on National Forest land; other Districts prohibit community dumps, but use their own small dumps for recreation wastes. Most Districts practice open burning when the forest fire hazard is not great, but there is little incineration on National Forest land. Some Districts, feeling a responsibility to provide disposal areas to nearby communities, freely offer sites. Some of these Districts limit the number of these sites; others do not. Most Districts require the city or county to operate the disposal site according to standards cited in the special land use permit they issue. In most cases, these standards specify that the site be operated at the level required by State laws and local ordinances.

At this time, few local areas have standards for land disposal site operations; and in remote areas, few States are able to enforce existing legislation. Study personnel found no land disposal sites that conformed to local standards where they existed.

At the District level, there was widespread misunderstanding of Federal standards concerning open dumps on Forest land. The May 1966 Executive Order No. 11282 ("Control of Air Pollution Originating from Federal Installations") revised Mar. 28, 1969 (Appendix 6), regulates all disposal operations on Federal land, whether federally, municipally, or privately conducted. Standards to implement the objectives of the Order, Title 42 of the Code of Federal Regulations, Part 76.8 (Appendix 6), prohibit open burning on Federal lands and require that "refuse shall not be left in dumps," and must be compacted and covered every evening after the landfill has been used regardless of its size or isolation. The methods used should be in accordance with those described in the Bureau of Solid Waste Management publication *Sanitary Landfill Facts.*[2]

Incineration, which is also covered by the Executive Order, is little used in the Forest Service for economic reasons. Where incinerators operate, they undoubtedly do so in violation of the strict emission standards set by the Order.

Capital and maintenance costs of incinerators cannot compete with free dumps. The mobile incinerator, used in experiments and field studies conducted by the Forest Service, has proven expensive, and like some small incinerators, probably will not meet Federal air pollution control standards.

The value of incineration in recreational areas is questionable. Between 21 and 45 percent of the components of solid waste encountered at campgrounds are noncombustibles. Another 10 percent of the remaining combustibles will probably remain unburned in the ash. As a result, only 45 to 70 percent of the weight will be reduced by incineration and about 80 percent of the volume. The remaining organics in the residue will still require daily cover. Although incineration will reduce waste volume, the Forest Service will not benefit from the reduction because the small volumes handled are not difficult to transport and because disposal sites need not be remote from recreation areas.

The problems of acceptably disposing of Forest Service recreation and administrative wastes should receive increased attention. Each District must see that their wastes receive acceptable disposal, whether in Forest Service–operated sanitary landfills or city–operated sanitary landfills or incinerators. Disposal, even without open burning, in private, city, or Forest Service dumps sets an unacceptably bad example.

The best way to improve existing community disposal sites on Forest Service land is to first demonstrate sanitary landfill techniques on Forest Service wastes in separate model sanitary landfills. Trenches for these landfills could be dug by private contract, just as they are for some dumps. Nearly every District has equipment that can compact and cover small amounts of solid waste after each collection, which as a minimum should be twice a week. Small tractors can in some cases be used and still be ready for other assignments if the sanitary landfill is located near its storage area. Four–wheel–drive pickups with blades, although not imparting optimum compaction, might do an adequate job. If these trucks are used for collection, they have the added advantage of already being at the disposal site when compaction and cover are needed.

Planning New Solid Waste Handling Systems

This report defines the major problem areas in managing solid wastes handling systems and also offers suggestions on how to improve the three major components of handling systems: storage, collection, and disposal.

New storage and collection systems or existing ones improved to include the suggestions in this report will not be drastically different from those existing in most Districts. Knowledge that the number of route miles collection crews travel is costly will encourage reduced crew sizes, enlarged interim storage capacity, and reduced collection frequency. Sanitary landfills will be located near major waste generating areas to reduce route miles of collection, but near enough to equipment storage areas to allow otherwise idle equipment to be used for compaction and cover.

Private collection and disposal will become more expensive as strict disposal standards are enforced. As solid waste management receives more attention, however, more enlightened analysis of the costs and benefits of private collection and disposal will ensure that, when private collection is selected, it will represent a true cost saving.

The need and the means to end open burning and open dumping have been shown. Sanitary landfills located near equipment garages permit existing equipment to be used with a minimum of interruption to other assigned tasks. The innovation of a collection–disposal vehicle is needed that will allow sanitary landfills to operate near waste sources, with a reduction in the number of collection route miles traveled.

Sanitary landfills need be operated only on collection days. Careful management of storage systems will reduce the need for frequent collection, and infrequent collection will reduce the frequency of disposal and will reduce solid waste management costs.

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ACKNOWLEDGMENTS

The Bureau of Solid Waste Management's Division of Technical Operations acknowledges the contributions of all participants of this study. District and Regional Forest Service personnel who helped arrange and conduct each District study are listed with each study site description (Appendix 2).

The study team members visited the Lake George District on the Ocala National Forest before establishing a method or a schedule of study. Personnel from that District, from the National Forests of Florida, and from the Forest Service Region 8 provided the initial influence and guidance that were instrumental in conducting the studies forming the basis for this report.

Walter Weaver and Richard Spray of the San Dimas Equipment Development Center coordinated the participation of the Forest Service in the project, and they also conducted three of the studies. Their zeal and guidance was essential to success.

Members of the Technical Assistance and Investigations Branch, Division of Technical Operations, participating in the field work were: Morris G. Tucker, Harry R. Little, F. Owen Irvine, Howard R. Ludwig, Ronald A. Perkins, and Charles S. Spooner.* Statistical work was done by Betty L. Grupenhoff and Albert J. Klee, Operations Analysis Branch, Division of Technical Operations.

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APPENDIX 1

NATIONAL FOREST CAMP AND PICNIC SITE*

ENVIRONMENTAL MODIFICATION	LEVELS OF: &	RECREATION EXPERIENCES
	DEVELOPMENT SCALE	
Minimum site modification. Rustic or rudimentary improvements designed for protection of the site rather than comfort of the users. Use of synthetic materials avoided. Minimum controls are subtle. No obvious means of regimentation. Spacing informal and extended to minimize contacts with others. Motorized access not provided or permitted.	1 primitive	Primitive forest environment is dominant. Rudimentary and isolated development sites beyond the sight or sound of inharmonious influences. Maximum opportunity for experiencing solitute, testing skills, and compensating for the routines of daily living. User senses no regimentation. Feeling of physical achievement in reaching site is important.
Little site modification. Rustic or rudimentary improvements designed for protection of the site rather than comfort of the users. Use of synthetic materials avoided. Minimum controls are subtle. Little obvious regimentation. Spacing informal and extended to minimize contacts with others. Motorized access provided or permitted. Primary access over primitive roads.	2 secondary primitive	Near primitive forest environment. Outside influences present but minimized. Feeling of accomplishment associated with low standard access is important but does not necessarily imply physical exertion to reach site. Opportunity for solitude and chance to test outdoor skills are present.
Site modification moderate. Facilities designed about equally for protection of site and comfort of users. Contemporary/rustic design of improvements is usually based on use of native materials. Inconspicuous vehicular traffic controls usually provided. Roads may be hard surfaced and trails formalized. Development density about three family units per acre. Primary access to site may be over high–standard well–traveled roads. Visitor Information Service, if available, is informal and incidental.	3 inter–mediate	Forest environment is essentially natural. Important that a degree of solitude be combined with some opportunity to socialize with others. Controls and regimentation provided for safety and well–being of user sufficiently obvious to afford a sense of security but subtle enough to leave the taste of adventure.

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* From: RIM [recreation information management] handbook. Forest Service Handbook 2309.11. U.S. Department of Agriculture, Sept. 1967.

Site heavily modified. Some facilities designed strictly for comfort and convenience of users, but luxury facilities not provided. Facility designs may tend toward and incorporate synthetic materials. Extensive use of artificial surfacing of roads and trails. Vehicular traffic controls present and usually obvious. Primary access usually over paved roads. Development density of three to five family units per acre. Plant materials usually native. Visitor Information Service frequently available.	4 secondary modern	Forest environment is pleasing and attractive but not necessarily natural. Blending of opportunities for solitude and socializing with others. Testing of outdoor skills on site mostly limited to the camping activity. Many user comforts available. Contrasts to daily living routines is moderate. Invites marked sense of security.
High degree of site modification. Facilities, mostly designed for comfort and convenience of users, include flush toilets and may include showers, bath houses, laundry facilities, and electrical hookups. Synthetic materials commonly used. Formal walks or surfaced trails. Regimentation of users is obvious. Access usually by high–speed highways. Development density of five or more family units per acre. Plant materials may be foreign to the environment. Formal Visitor Information Service usually available. Designs formalized and architecture may be contemporary. Mowed lawns and clipped shrubs not unusual. (Class 5 sites only provided in special situations or close to large cities where other lands are not available.)	5 modern	Pleasing environment attractive to the novice or highly gregarious camper. Opportunity to socialize with others very important. Satisfies urbanites' need for compensating experiences and relative solitude but less intensive than in classes 1 to 4. Obvious to user that he is in secure situation where ample provision is made for his personal comfort and he will not be called upon to use undeveloped skills.

APPENDIX 2

DESCRIPTIONS OF INDIVIDUAL STUDIES

The agencies involved in these studies and their organizational structure, with the abbreviations used in Appendix 2, are as follows:

U.S. Department of Health, Education, and Welfare	HEW
Public Health Service	PHS
Consumer Protection and Environmental Health Service	CPEHS
Environmental Control Administration	ECA
Bureau of Solid Waste Management	BSWM
U.S. Department of Agriculture	USDA
Forest Service	FS
San Dimas Equipment Development Center	SDEDC
Washington Office	WO
National Forest	NF
Ranger District	RD

In the tables of Appendix 2, a dash indicates that no data were available, a zero indicates that the observed value of an item was zero, and blanks mean that the corresponding items were not studied.

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SOLID WASTE STUDY, JUNE 26 – JULY 1, 1969

ALLEGHENY NATIONAL FOREST, PENNSYLVANIA

SITES STUDIED:

- Hearts Content Campground (1)
- Minister Creek Campground (2)
- Buckaloons Campground (3) and Picnic Area (5)
- Kiasutha Campground (4), Swimming Area (6), and Boat Ramp (7)
- Jakes Rock Overlook (8)
- Camp Cornplanter Organization Camp (9)

PERSONNEL:

Study Team: Charles S. Spooner and F. Owen Irvine, BSWM, ECA; and Walter S. Weaver, SDEDC, FS.
Local Staff: James Sleeper, Region 9, FS; and Richard Schmeltzer, Marienville RD, Allegheny NF.

ALLEGHENY NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Hearts Content Campground				
Pounds of waste generated	16.3	27.0	94.0	100.0
Visitor days contributing	26.7	26.7	71.7	165
Pounds/visitor day	0.61	1.01	1.31	0.61
Camper days contributing	16	16	43	99
Pounds/camper day	1.02	1.69	2.19	1.01
Composition (percent*)				
Food wastes	–	39	61.6	48.5
Other combustibles	–	18	17.2	21.2
Noncombustibles	–	43	21.2	30.3
(2) Minister Creek Campground				
Pounds of waste generated	37.2	22.0	42.8	64.0
Visitor days contributing	25	33.4	70.0	85.0
Pounds/visitor day	1.49	0.66	0.61	0.75
Camper days contributing	15	20	42	51
Pounds/camper day	2.48	1.10	1.02	1.25
Composition (percent)				
Food wastes	–	38.3	32.3	43
Other combustibles	–	19.5	21.7	18
Noncombustibles	–	42.2	46.0	39

ALLEGHENY NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Buckaloons Campground				
Pounds of waste generated	98.2	104.0	215.4	192.0
Visitor days contributing	118.9	152.7	188.9	198.2
Pounds/visitor day	0.83	0.68	1.14	0.97
Camper days contributing	102	131	162	170
Pounds/camper day	0.96	0.79	1.33	1.13
Composition (percent)				
Food wastes	23.0	35.6	41	37
Other combustibles	27.5	24.4	24	22
Noncombustibles	49.5	40.0	35	41
(4) Kiasutha Campground				
Pounds of waste generated	426.4	325.9	668.0	578.4
Visitor days contributing	666	672	688	675
Pounds/visitor day	0.64	0.48	0.97	0.86
Camper days contributing	444	448	459	450
Pounds/camper day	0.96	0.73	1.45	1.28
Composition (percent)				
Food wastes	47.9	37.5	40.7	42.2
Other combustibles	24.0	36.1	35.2	27.3
Noncombustibles	28.1	26.4	24.1	30.5
(5) Buckaloons Picnic Area				
Pounds of waste generated	6.3	11.1	21.0	34.2
Picnickers contributing	–	13	7	–
Pounds/picnicker	–	0.85	3.0	–
Composition (percent)				
Food wastes	23	37	45	37
Other combustibles	27	23	21	22
Noncombustibles	50	40	34	41
(6) Kiasutha Swimming Area				
Pounds of waste generated			53.6	18.7
Swimmers contributing			425	600
Pounds/swimmer			0.13	0.03
Composition (percent)				
Food wastes			33	12
Other combustibles			32	43
Noncombustibles			35	45

ALLEGHENY NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(7) Kiasutha Boat Ramp				
Pounds of waste generated			47.5	13.5
Boats contributing			83	45
Pounds/boat			0.57	0.30
(8) Jakes Rock Overlook				
Pounds of waste generated	9.0	0.75	16.1	1.0
Number of incoming axles	74	80	328	52
Pounds/incoming axle	0.12	0.01	0.05	0.02
(9) Camp Cornplanter Organization Camp				
Pounds of waste generated	487	0	162	354
Occupant days contributing	220		196	150
Pounds/occupant day	2.21		0.83	2.36
Composition (percent)				
Food wastes	74.2	/	46.3	62.1
Other combustibles	13.1	/	28.9	18.1
Noncombustibles	12.7	/	24.8	19.8

* All percents by weight.

SOLID WASTE STUDY, JULY 12–15, 1968

DESCHUTES NATIONAL FOREST, OREGON

SITES STUDIED:

- Prairie Campground (1)
- Paulina Lake Campground (2), Boating Area (14), and Recreation Residences (11)
- East Lake Campground (3), Resort Cabins (10), Restaurant (12), and Boating Area (15)
- Princess Creek Campground (4) and Boating Area (16)
- Trapper Creek Campground (5) and Boating Area (17)
- Cinder Hill Campground (6) and Boating Area (18)
- Crescent Lake Organization Camp (7)
- Odell–Summit Lodge (8) and Cabins (9)
- Lava Butte Visitor Center (13)

PERSONNEL:

Study Team: Harry R. Little, Ronald A. Perkins, and Howard R. Ludwig, BSWM, ECA; Ransom H. Martin, TVA (assigned for training to the BSWM); and Richard H. Spray, SDEDC, FS.

Local Staff: Douglas C. Roth, Region 6, FS; and Bert Houston, Fort Rock RD, and Lyle Greenwood, Crescent RD, Deschutes NF.

DESCHUTES NATIONAL FOREST
GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Prairie Campground				
Pounds of waste generated	15.5	14.5	8.5	34.0
Visitor days contributing	22	15	18	7
Pounds/visitor day	0.70	0.97	0.47	4.86
Camper days contributing	22	15	18	7
Pounds/camper day	0.70	0.97	0.47	4.86
Composition (percent*)				
Food wastes	25.7	30.9	17.0	41.2
Other combustibles	32.9	27.8	29.8	22.0
Noncombustibles	41.4	41.3	53.2	36.8
(2) Paulina Lake Campground				
Pounds of waste generated	264.0	109.5	188.0	231.0
Visitor days contributing	206	182	221	188
Pounds/visitor day	1.28	0.60	0.85	1.23
Camper days contributing	155	137	166	141
Pounds/camper day	1.70	0.80	1.13	1.64
Composition (percent)				
Food wastes	32.6	35.2	26.4	26.8
Other combustibles	31.5	39.8	29.5	30.8
Noncombustibles	24.6	20.1	36.2	37.3
Fish cleaning wastes	11.3	4.9	7.9	5.1

DESCHUTES NATIONAL FOREST – CONTINUED

Area	Day of waste generation Thursday	Friday	Saturday	Sunday
(3) East Lake Campground				
Pounds of waste generated	166.5	118.5	166.0	206.5
Visitor days contributing	153	197	202	138
Pounds/visitor day	1.09	0.60	0.82	1.49
Camper days contributing	115	148	152	104
Pounds/camper day	1.45	0.80	1.09	1.98
Composition (percent)				
Food wastes	37.5	30.7	27.6	37.0
Other combustibles	26.4	35.0	31.0	19.2
Noncombustibles	30.1	27.0	35.2	39.8
Fish cleaning wastes	6.0	7.3	6.2	4.0
(4) Princess Creek Campground				
Pounds of waste generated	181.5	122.5	146.5	160.5
Visitor days contributing	162	176	216	158
Pounds/visitor day	1.12	0.70	0.68	1.01
Camper days contributing	122	132	162	119
Pounds/camper day	1.49	0.93	0.90	1.35
Composition (percent)				
Food wastes	33.6	44.1	42.3	44.4
Other combustibles	40.3	34.4	33.3	31.9
Noncombustibles	26.1	21.5	24.4	23.7
(5) Trapper Creek Campground				
Pounds of waste generated	228.5	146.0	234.5	217.5
Visitor days contributing	158	193	325	193
Pounds/visitor day	1.44	0.76	0.72	1.13
Camper days contributing	119	145	244	145
Pounds/camper day	1.92	1.01	0.96	1.50
Composition (percent)				
Food wastes	37.0	46.0	40.6	38.0
Other combustibles	29.7	31.0	32.3	30.7
Noncombustibles	33.3	23.0	27.1	31.3
(6) Cinder Hill Campground				
Pounds of waste generated	209.0	210.0	329.0	215.0
Visitor days contributing	246	315	301	128
Pounds/visitor day	0.85	0.67	1.09	1.68
Camper days contributing	185	237	226	96
Pounds/camper day	1.13	0.89	1.46	2.24
Composition (percent)				
Food wastes	28.2	26.2	26.8	26.7
Other combustibles	37.6	38.6	29.0	32.1
Noncombustibles	32.8	35.2	37.7	37.6
Fish cleaning wastes	1.4	0.0	6.5	3.6

DESCHUTES NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(7) Crescent Lake Organization Camp				
Pounds of waste generated	129.0	175.5	0	80.0
Occupant days contributing	96	58		75
Pounds/occupant day	1.34	3.03		1.07
Composition (percent)				
Food wastes	57.3	59.0		3.7
Other combustibles	34.1	26.8		25.6
Noncombustibles	8.6	14.2		70.7
(8) Odell–Summit Lodge†				
Pounds of waste generated	8.5	44.5	26.0	37.0
Visitor days contributing	–	–	–	–
Meals served	7	25	48	57
Composition (percent)				
Food wastes	52.9	47.2	32.7	37.8
Other combustibles	35.3	27.0	23.1	20.3
Noncombustibles	11.8	25.8	44.2	41.9
(9) Odell–Summit Lodge Cabins (without kitchens)				
Pounds of waste generated	6.5	10.0	26.0	21.0
Occupant days contributing	3	19	19	15
Pounds/occupant day	2.20	0.53	1.62	1.40
Composition (percent)				
Food wastes	70	25	38.4	26.2
Other combustibles	15	60	38.4	40.5
Noncombustibles	15	15	23.2	33.3
(10) East Lake Resort Cabins				
Pounds of waste generated	53.0	87.5	145.5	111.0
Occupant days contributing	35	57	66	25
Pounds/occupant day	1.51	1.53	2.20	4.44
(11) Paulina Lake Recreation Residences‡				
Pounds of waste generated	12.5	73.0	107.0	18.5
Cabins contributing	4	4	4	3
Occupant days contributing	14	15	15	14
Pounds/occupant day	0.89	4.86	7.13	1.32
Composition (percent)				
Food wastes	38.5	80	83	40
Other combustibles	15.3	20	0	20
Noncombustibles	46.2	0	17	40

DESCHUTES NATIONAL FOREST – CONTINUED

Area	Day of waste generation Thursday	Friday	Saturday	Sunday
(12) East Lake Resort Restaurant§				
Pounds of waste generated	69.5	24.0	40.0	68.0
Number of meals served	14	39	23	12
Pounds/meal	4.96	0.62	1.74	5.67
Composition (percent)				
Food wastes	8.6	43.8	31	16.3
Other combustibles	87.3	39.5	54	38.9
Noncombustibles	4.1	16.7	15	44.8
(13) Lava Butte Visitor Center				
Pounds of waste generated	30.5	5.5	14.5	4.0
Visitors contributing	500	289	350	500
Pounds/visitor	0.06	0.02	0.04	0.01
Composition (percent)				
Food wastes	8.2	9.0	6.9	0.0
Other combustibles	60.7	72.8	79.3	37.5
Noncombustibles	31.1	18.2	13.8	62.5
(14) Paulina Lake Boating Area				
Pounds of waste generated	9.5	3.0	1.0	7.5
Boats contributing	19	22	19	16
Pounds/boat	0.50	0.14	0.05	0.47
(15) East Lake Boating Area				
Pounds of waste generated	7.5	1.0	0.0	5.0
Boats contributing	11	11	24	15
Pounds/boat	0.68	0.09	0.0	0.33
(16) Princess Creek Boating Area				
Pounds of waste generated	1.0	0.0	1.0	1.0
Boats contributing	40	28	26	11
Pounds/boat	0.02	0.0	0.04	0.09
(17) Trapper Creek Boating Area				
Pounds of waste generated	0.0	1.0	2.0	3.0
Boats contributing	24	34	46	29
Pounds/boat	0.0	0.03	0.04	0.10

DESCHUTES NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(18) Cinder Hill Boating Area				
Pounds of waste generated	9.0	3.0	16.0	10.5
Boats contributing	23	28	33	7
Pounds/boat	0.39	0.11	0.48	1.50

* All percents by weight.
† Wastes were collected from lodges, boat ramps, office, and kitchen.
‡ Wastes from one home on Saturday consisted of 50 lb of wood chips.
§ This restaurant was a small hamburger stand.

SOLID WASTE STUDY, JULY 19–22, 1968

ELDORADO NATIONAL FOREST, CALIFORNIA

SITES STUDIED:

- Fallen Leaf Campground (1)
- Camp Richardson Cabins (2), Restaurant (3), and Lodge (4)
- Lake Tahoe Visitor Center (5)
- Camp Concord Organization Camp (6)
- Spring Creek Recreation Residences (7)

PERSONNEL:

Study Team: Harry R. Little and Howard R. Ludwig, BSWM, ECA; and Richard H. Spray, SDEDC, FS.
Local Staff: Robert McLaughlin, Region 5, FS; and James Olson, Lake Valley RD, Eldorado NF.

ELDORADO NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Fallen Leaf Campground				
Pounds of waste generated	520.0	708.7	857.5	712.5
Visitor days contributing	640	705	795	644
Pounds/visitor day	0.81	1.01	1.08	1.11
Camper days contributing	640	705	795	644
Pounds/camper day	0.81	1.01	1.08	1.11
Composition (percent*)				
Food wastes	22.2	28.7	28.7	34.2
Other combustibles	38.3	35.6	31.5	39.6
Noncombustibles	39.5	35.7	39.8	26.2
(2) Camp Richardson Cabins				
Pounds of waste generated		258.5	288.5	164.5
Occupant days contributing		180	180	180
Pounds/occupant day		1.44	1.60	0.92
Composition (percent)				
Food wastes		26.6	23.8	28.5
Other combustibles		44.4	43.5	51.3
Noncombustibles		29.0	32.7	20.2
(3) Camp Richardson Restaurant				
Pounds of waste generated		69.5	196.0	51.0
Meals served		183	228	141
Pounds/meal served		0.38	0.86	0.36
Composition (percent)				
Food wastes		72.6	69.3	37.2
Other combustibles		23.0	24.2	52.9
Noncombustibles		4.4	6.5	9.9

ELDORADO NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(4) Camp Richardson Lodge				
Pounds of waste generated		10.0	8.0	24.5
Occupant days contributing		37	58	25
Pounds/occupant day		0.27	0.14	0.98
Composition (percent)				
Food wastes		0	0	0
Other combustibles		80	75	82
Noncombustibles		20	25	18
(5) Lake Tahoe Visitor Center				
Pounds of waste generated	5.8	3.0	6.5	4.5
Visitors contributing	503	413	625	536
Pounds/visitor	0.012	0.007	0.010	0.010
Composition (percent)				
Food wastes	0	0	0	0
Other combustibles	100	70	75	70
Noncombustibles	0	30	25	30
(6) Camp Concord Organization Camp				
Pounds of waste generated	129.1	218.5	169.0	173.5
Occupant days contributing	94	90	95	97
Pounds/occupant day	1.37	2.43	1.78	1.79
Composition (percent)				
Food wastes	68.6	25.6	73.4	65.7
Other combustibles	23.8	26.5	20.7	28.5
Noncombustibles	7.6	47.9	5.9	5.8
(7) Spring Creek Recreation Residences				
Pounds of waste generated	67.0	94.5	113.0	149.5
Cabins occupied	7	14	12	12
Occupant days contributing	30	54.5	65.5	52.5
Pounds/occupant day	2.23	1.73	1.73	2.85
Composition (percent)				
Food wastes	20.3	36.5	31.6	19.8
Other combustibles	27.6	33.3	48.5	31.6
Noncombustibles	52.1	30.2	19.9	48.6

* All percents by weight.

SOLID WASTE STUDY, JULY 10–15, 1968
GALLATIN NATIONAL FOREST, MONTANA

SITES STUDIED:

- Beaver Creek Campground (1)
- Bakers Hole Campground (2)
- Cabin Creek Picnic Area (3)
- Earthquake Visitor Center (4)
- Lakeshore "Block E" Recreation Residences (5)
- Administrative Residences (6)

PERSONNEL:

Study Team: Charles S. Spooner and F. Owen Irvine, BSWM, ECA; and Walter S. Weaver, SDEDC, FS.
Local Staff: Howard Challinor, Assistant District Ranger, and Guy Hanson, Recreation Technician, Hebgen Lake RD; and Larry Cronenwett, Project Engineer, Gallatin NF.

GALLATIN NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation Thursday	Friday	Saturday	Sunday
(1) Beaver Creek Campground				
Pounds of waste generated	356.8	318.2	330.0	356.8
Visitor days contributing	217.5	156.0	220.5	117.0
Pounds/visitor day	1.64	2.03	1.50	3.05
Camper days contributing	145	104	147	78
Pounds/camper day	2.46	3.06	2.24	4.57
Composition (percent*)				
Food wastes	28.7	42	30.5	39.0
Other combustibles	27.4	25	25.8	21.5
Noncombustibles	43.9	33	43.7	39.5
(2) Bakers Hole Campground				
Pounds of waste generated	229.0	166.2	254.8	210.5
Visitor days contributing	242.7	346.3	448.9	420.9
Pounds/visitor day	0.94	0.48	0.57	0.50
Camper days contributing	283	297	385	361
Pounds/camper day	0.81	0.56	0.66	0.58
Composition (percent)				
Food wastes	34	39.3	35.6	42.3
Other combustibles	31	28.3	31.0	20.5
Noncombustibles	35	32.4	33.4	37.2

GALLATIN NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Cabin Creek Picnic Area				
Pounds of waste generated		14.1	21.7	76.0
Estimated picnickers contributing		10	20	36
Pounds/picnicker		1.4	1.1	2.1
Composition (percent)				
Food wastes		19.5	38.7	36.5
Other combustibles		47.9	26.5	25.9
Noncombustibles		32.6	34.8	37.6
(4) Earthquake Visitor Center				
Pounds of waste generated	17.0	10.8	13.2	25.3
Estimated visitors contributing	785	622	619	778
Pounds/visitor	0.022	0.017	0.021	0.033
Composition (percent)				
Food wastes	8.8	13.9	6.1	32.0
Other combustibles	58.8	35.2	31.8	23.3
Noncombustibles	32.4	50.9	62.1	44.7
(5) Lakeshore "Block E" Recreation Residences				
Pounds of waste generated		61.3	61.5	9.4
Cabins contributing		6	4	3
Occupant days contributing		29	27	10
Pounds/occupant day		2.12	2.28	0.94
Composition (percent)				
Food wastes		33.0	50.8	–
Other combustibles		17.1	11.8	–
Noncombustibles		49.9	37.4	–
(6) Administrative Residences				
Pounds of waste generated		38.5	17.8	31.8
Homes contributing		4	4	4
Occupants		31	14	14
Pounds/occupant		1.24	1.27	2.28
Composition (percent)				
Food wastes		29.4	16.9	45.7
Other combustibles		37.4	19.5	28.3
Noncombustibles		33.2	63.6	26.0

* All percents by weight.

SOLID WASTE STUDY, JUNE 21–24, 1968

HURON–MANISTEE NATIONAL FOREST, MICHIGAN

SITES STUDIED:

Lake Michigan Campground (1)
Sand Lake Campground (2), Picnic Area (3), and Administrative Residence (4)
Hoxey Job Corps Civilian Conservation Center (5)

PERSONNEL:

Study Team: Charles S. Spooner and F. Owen Irvine, BSWM, ECA; and Walter S. Weaver, SDEDC, FS.
Local Staff: James Sleeper, Region 9, FS; and Kenneth Ruehle, Manistee RD, Huron–Manistee NF.

HURON–MANISTEE NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Lake Michigan Campground				
Pounds of waste generated	4.3	15.0	37.5	43.5
Visitor days contributing	3.33	30.0	68.3	96.7
Pounds/visitor day	1.29	0.50	0.55	0.45
Camper days contributing	2	18	41	58
Pounds/camper day	2.15	0.83	0.91	0.75
Composition (percent*)				
Food wastes	8.0	–	53.5	45.5
Other combustibles	33.2	–	13.2	16.5
Noncombustibles	58.8	–	33.3	38.0
(2) Sand Lake Campground				
Pounds of waste generated	89.8	125.0	316.4	149.5
Visitor days contributing	281.7	281.7	378.4	335.1
Pounds/visitor day	0.32	0.44	0.84	0.45
Camper days contributing	169	169	227	201
Pounds/camper day	0.53	0.73	1.39	0.74
Composition (percent)				
Food wastes	34.0	42.5	53.2	45.9
Other combustibles	26.4	21.9	18.7	22.9
Noncombustibles	34.6	35.6	28.1	31.2

HURON–MANISTEE NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Sand Lake Picnic Area				
Pounds of waste generated	38.0	0.0	25.5	24.5
Picnickers contributing	–		–	–
Composition (percent)				
Food wastes	51		32	45
Other combustibles	15		29	34
Noncombustibles	34		39	21
(4) Sand Lake Administrative Residence				
Pounds of waste generated	8	6	7	5
Occupant days contributing	6	6	6	6
Pounds/occupant day	1.33	1.00	1.16	0.83
(5) Hoxey Job Corps Civilian Conservation Center				
Kitchen wastes:				
Pounds of waste generated		396		451
Corpsmen days contributing		160		139
Pounds/corpsmen day		2.47		3.25
Composition (percent)				
Food wastes		54		68
Other combustibles		39		23
Noncombustibles		7		9
Administrative and dormitory wastes:				
Pounds of waste generated		78		169
Corpsmen days contributing		160		139
Pounds/corpsmen day		0.49		1.22
Composition (percent)				
Food wastes		0		0
Other combustibles		100		100
Noncombustibles		0		0
Staff residence wastes:				
Pounds of waste generated		54		169
Staff days contributing		28		98
Pounds/staff day		1.93		1.73
Composition (percent)				
Food wastes		32.0		20
Other combustibles		37.5		41
Noncombustibles		30.5		39

* All percents by weight.

SOLID WASTE STUDY, JULY 19–22, 1968

KANIKSU NATIONAL FOREST, IDAHO

SITES STUDIED:

Samowen Campground (1) and Group Picnic Area (2)
Garfield Bay Recreation Residences (3)
Priest Lake Ranger Station (4)

PERSONNEL:

Study Team: Charles S. Spooner and F. Owen Irvine, BSWM, ECA; and Walter S. Weaver, SDEDC, FS.
Local Staff: David Rudd, Assistant Forest Engineer, Kaniksu NF; and Maxwell Cochrane and Gary Stensatter, Region 1, FS.

KANIKSU NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Samowen Campground				
Pounds of waste generated	155.2	108.1	178.8*	238.3
Visitor days contributing	239	244.8	303.9	337.2
Pounds/visitor day	0.65	0.44	0.59	0.71
Camper days contributing	151	142	192	213
Pounds/camper day	1.03	0.76	0.93	1.12
Composition (percent†)				
Food wastes	36.2	27.1	50.6	49.8
Other combustibles	9.3	21.6	11.4	11.9
Noncombustibles	54.5	51.3	38.0	38.3
(2) Samowen Group Picnic Area				
Pounds of waste generated	0	67.1	91.4	0
Picnickers contributing		57	120	
Pounds/picnicker		1.18	0.76	
Composition (percent)				
Food wastes		23.2	23.2	
Other combustibles		35.3	31.4	
Noncombustibles		41.5	45.4	

KANIKSU NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Garfield Bay Recreation Residences				
Pounds of waste generated	0	13.6	26.0	12.9
Cabins occupied		3	5	4
Occupant days contributing		9	29	20
Pounds/occupant day		1.51	0.90	0.65
Composition (percent)				
Food wastes		38.0	61.3	44.3
Other combustibles		23.2	10.5	18.3
Noncombustibles		38.8	28.2	37.4
(4) Priest Lake Ranger Station				
Kitchen wastes:				
Pounds of waste generated	39	25.3	51.8	
Number of meals served	43	25	51	
Pounds of waste/meal	0.91	1.01	1.02	
Composition (percent)				
Food wastes	89.7	61.4	79.3	
Other combustibles	2.6	32.7	12.0	
Noncombustibles	7.7	5.9	8.7	
Administrative and warehouse wastes:				
Pounds of waste generated	8.8	5.1	12.3	
Composition (percent)				
Combustibles	100	88	53	
Noncombustibles	0	12	47	
Bunk house wastes:				
Pounds of waste generated	6.0	1.0	5.3	
Occupants contributing	36	36	29	
Composition (percent)				
Combustibles	71	100	43	
Noncombustibles	29	0	57	

* Campground signs encouraged burning combustibles in camp fireplaces. The large fraction of combustible wastes collected on Saturday indicated heavy rains on Friday discouraged many people from doing so.

† All percents by weight.

SOLID WASTE STUDY, SEPTEMBER 5–9, 1968

LINCOLN NATIONAL FOREST, NEW MEXICO

SITES STUDIED:

Pine Campground (1)
Sleepy Grass Campground (2) and Picnic Area (5)
Deerhead Campground (3)
Silver Campground (4)
Slide Group Picnic Area (6)

PERSONNEL:

Study Team: Harry R. Little and Howard R. Ludwig, BSWM, ECA; and Walter S. Weaver, SDEDC, FS.
Local Staff: T.C. Hogsett, Region 3, FS; and Roy McKeag, State of New Mexico Health and Social Services Department.

LINCOLN NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Pine Campground				
Pounds of waste generated		2.0	25.4	60.6
Visitor days contributing		6	21	42
Pounds/visitor day		0.33	1.21	1.44
Camper days contributing		6	21	42
Pounds/camper day		0.33	1.21	1.44
Composition (see below)				
(2) Sleepy Grass Campground				
Pounds of waste generated	2.0	19.1	46.5	27.3
Visitor days contributing	3	14	27	8
Pounds/visitor day	0.67	1.36	1.72	3.4
Camper days contributing	3	14	27	8
Pounds/camper day	0.67	1.36	1.72	3.4
Composition (see below)				

LINCOLN NATIONAL FOREST – CONTINUED

Area	Day of waste generation Thursday	Friday	Saturday	Sunday
(3) Deerhead Campground				
Pounds of waste generated	3.0	14.5	49.7	38.8
Visitor days contributing	2	8	26	12
Pounds/visitor day	1.50	1.82	1.91	3.23
Camper days contributing	2	8	26	12
Pounds/camper day	1.50	1.82	1.91	3.23
Composition (see below)				
(4) Silver Campground				
Pounds of waste generated	–	20.0	87.4	99.8
Visitor days contributing	–	15	47	35
Pounds/visitor day	–	1.33	1.86	2.85
Camper days contributing	–	15	47	35
Pounds/camper day	–	1.33	1.86	2.85
Composition (see immediately below)				
Composition (percent*)†				
Food wastes	26.6	38.3	37.2	31.3
Other combustibles	36.7	32.8	35.3	45.1
Noncombustibles	36.7	28.9	27.5	23.6
(5) Sleepy Grass Picnic Area				
Pounds of waste generated	24.3	12.5	17.6	231.3
Picnickers contributing	29	14	–	214
Pounds/picnicker	0.83	0.89	–	1.08
Composition (percent)				
Food wastes	21.2	60	30	44
Combustibles	34.6	14	34	33
Noncombustibles	44.2	26	36	23
(6) Slide Group Picnic Area				
Pounds of waste generated	0	0	91.8	0
Picnickers contributing			55	
Pounds/picnicker			1.67	
Composition (percent)				
Food wastes			27.2	
Combustibles			36.3	
Noncombustibles			36.5	

* All percents by weight.

† Because there was so little camping, composition was measured for all campgrounds together.

SOLID WASTE STUDY, JUNE 14–17, 1968

NATIONAL FOREST OF MISSISSIPPI

SITES STUDIED:

Raworth Campground (1) and Picnic Area (3)
Shongelo Campground (2), Picnic Area (4), and Swimming Area (5)

PERSONNEL:

Study Team: Harry R. Little and Morris G. Tucker, BSWM, ECA; and Richard H. Spray, SDEDC, FS.
Local Staff: James Armfield, Region 8, FS; and Henry W. Gilreath, Bienville RD, NF of Mississippi.

NATIONAL FOREST OF MISSISSIPPI

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Raworth Campground				
Pounds of waste generated	17	0	9	9
Visitor days contributing	–		–	–
Pounds/visitor day	–		–	–
Camper days contributing	6		5	5
Pounds/camper day	2.83		1.80	1.80
Composition (percent*)				
Food wastes	23.5		11.0	0.0
Other combustibles	53.0		44.5	77.8
Noncombustibles	23.5		44.5	22.2
(2) Shongelo Campground				
Pounds of waste generated	0	1	16	9
Visitor days contributing		–	–	–
Pounds/visitor day		–	–	–
Camper days contributing		4	4	4
Pounds/camper day		0.25	4.00	2.25
Composition (percent)				
Food wastes		–	18.7	11.1
Other combustibles		–	25.0	22.2
Noncombustibles		–	56.3	66.7

NATIONAL FOREST OF MISSISSIPPI – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Raworth Picnic Area				
Pounds of waste generated	43	37	75	112
Visitor days contributing	25	21	43	64
Pounds/visitor day	1.72	1.76	1.74	1.75
Composition (percent)				
Food wastes	34.9	13.6	46.6	30.4
Other combustibles	39.5	43.2	26.7	26.8
Noncombustibles	25.6	43.2	26.7	42.8
(4) Shongelo Picnic Area				
Pounds of waste generated	43	5	42	38
Visitor days contributing	10	2	10	10
Pounds/visitor day	4.30	2.50	4.20	3.80
Composition (percent)				
Food wastes	48.9	0	83.4	60.5
Other combustibles	9.3	80	11.9	29.0
Noncombustibles	41.8	20	4.7	10.5
(5) Shongelo Swimming Area				
Pounds of waste generated	–	–	–	27 †
Visitor days contributing	–	–	–	155 †
Pounds/visitor day	–	–	–	0.17 †
Composition (percent)				
Food wastes	0.0	0	0	0
Other combustibles	46.1	70	50	50
Noncombustibles	53.9	30	50	50

* All percents by weight.

† Total for entire 4 days.

SOLID WASTE STUDY, JUNE 21–24, 1968

OZARK NATIONAL FOREST, ARKANSAS

SITES STUDIED:

Spring Lake Campground (1), Picnic Area (3), Swimming Area (6), and Concession Stand (8)
Cove Lake Campground (2), Picnic Area (4), Swimming Area (7), and Concession Stand (9)
Mt. Magazine Picnic Area (5), Cabins (10), and Lodge (11)

PERSONNEL:

Study Team: Harry R. Little and Morris G. Tucker, BSWM, ECA; and Richard H. Spray, SDEDC, FS.
Local Staff: James Armfield, Region 8, FS; William E. Gates, Forest Engineers Office, FS; and Leonard A. Minton, Mt. Magazine RD, Ozark NF.

OZARK NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Spring Lake Campground				
Pounds of waste generated	33	22	59	81
Visitor days contributing	34.5	27.0	78.0	84.0
Pounds/visitor day	0.96	0.81	0.76	0.96
Camper days contributing	23	18	52	56
Pounds/camper day	1.43	1.22	1.14	1.45
Composition (percent*)				
Food wastes	39.9	23	30.7	37.2
Other combustibles	30.1	32	34.2	29.7
Noncombustibles	30.0	45	35.1	33.1
(2) Cove Lake Campground				
Pounds of waste generated	96	150	142	140
Visitor days contributing	117.0	97.5	123.0	97.5
Pounds/visitor day	0.82	1.54	1.15	1.44
Camper days contributing	78	65	82	65
Pounds/camper day	1.23	2.31	1.73	2.16
Composition (percent)				
Food wastes	37.5	45.9	53.2	60.2
Other combustibles	36.5	33.3	26.0	21.3
Noncombustibles	26.0	20.8	20.8	18.5

OZARK NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) Spring Lake Picnic Area				
Pounds of waste generated	44	36	28	106
Visitor days contributing	–	–	–	221†
Pounds/visitor day	–	–	–	0.97†
Composition (percent)				
Food wastes	59.2	72.2	39.3	66.0
Other combustibles	22.7	13.9	35.7	17.0
Noncombustibles	18.1	13.9	25.0	17.0
(4) Cove Lake Picnic Area				
Pounds of waste generated	143	47	16	58
Visitor days contributing	–	–	–	272†
Pounds/visitor day	–	–	–	0.97†
Composition (percent)				
Food wastes	44.0	43.7	25.0	34.5
Other combustibles	30.8	34.0	31.2	37.9
Noncombustibles	25.2	22.3	43.8	27.6
(5) Mt. Magazine Picnic Area				
Pounds of waste generated	30	5	9	27
Picnickers contributing	–	–	–	–
Composition (percent)				
Food wastes	35	40	60	73.9
Other combustibles	45	40	20	17.4
Noncombustibles	20	20	20	8.7
(6) Spring Lake Swimming Area				
Pounds of waste generated	4	11	3	3
Visitor days contributing	–	–	–	221†
Pounds/visitor day	–	–	–	0.10†
Composition (percent)				
Food wastes	0	45.5	0	33.3
Other combustibles	50	54.5	100	33.3
Noncombustibles	50	0.0	0	33.4
(7) Cove Lake Swimming Area				
Pounds of waste generated	11	10	2	8
Visitor days contributing	–	–	–	272†
Pounds/visitor day	–	–	–	0.11†
Composition (percent)				
Food wastes	0	0	0	0
Other combustibles	82	90	100	50
Noncombustibles	18	10	0	50

OZARK NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(8) Spring Lake Concession Stand				
Pounds of waste generated	5	4	11	15
Visitor days contributing	–	–	–	–
Composition (percent)				
Food wastes	0	0	9	7
Other combustibles	60	75	73	60
Noncombustibles	40	25	18	33
(9) Cove Lake Concession Stand				
Pounds of waste generated	14	20	19	17
Visitor days contributing	–	–	–	–
Composition (percent)				
Food wastes	7	0	0	9.1
Other combustibles	60	60	75	72.7
Noncombustibles	33	40	25	18.2
(10) Mt. Magazine Cabins (without kitchens)				
Pounds of waste generated	12	12	19	40
Occupant days contributing	–	–	–	84 †
Pounds/occupant day	–	–	–	0.99 †
Composition (percent)				
Food wastes	58.7	41.7	26.3	20
Other combustibles	21.5	33.3	31.6	30
Noncombustibles	19.8	25.0	42.1	50
(11) Mt. Magazine Lodge				
Pounds of waste generated	16	12	105	60
Overnight guests contributing	–	–	–	54 †
Pounds/overnight guest	–	–	–	3.57 †
Meals served	–	–	–	326 †
Composition (percent)				
Food wastes	93.8	50.0	92.4	88.3
Other combustibles	6.2	41.6	3.8	10.0
Noncombustibles	0.0	8.4	3.8	1.7

* All percents by weight.

† Total for 4 days; double sample techniques employed to estimate visitor days.

SOLID WASTE STUDY, AUGUST 23–26, 1968

RIO GRANDE NATIONAL FOREST, COLORADO

SITES STUDIED:

Palisade Campground (1)
Big Meadows Campground (2)
South Fork Campground (3)
Beaver Creek Campground (4) and Organization Camp (5)

PERSONNEL:

Study Team: Walter S. Weaver and Richard Spray, SDEDC, FS.
Local Staff: William Kolzow, Region 2, FS.

RIO GRANDE NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(1) Palisade Campground				
Pounds of waste generated	41	110	56	33
Visitor days contributing	27.2	88.0	62.0	73.0
Pounds/visitor day	1.50	1.25	0.90	0.45
Camper days contributing	30	28	46	32
Pounds/camper day	1.37	3.93	1.22	1.03
Composition (percent*)				
Food wastes	39.0	15.9	28.5	23.5
Other combustibles	29.3	36.4	42.9	32.3
Noncombustibles	31.7	47.7	28.6	44.2
(2) Big Meadows Campground				
Pounds of waste generated	99	180	68	117
Visitor days contributing	110.0	103.4	130.0	86.7
Pounds/visitor day	0.90	1.74	0.52	1.35
Camper days contributing	66	62	78	52
Pounds/camper day	1.50	2.90	0.87	2.25
Composition (percent)				
Food wastes	35.7	38.3	23.5	30.5
Other combustibles	39.8	32.8	42.1	38.9
Noncombustibles	24.5	28.9	34.4	30.6

RIO GRANDE NATIONAL FOREST – CONTINUED

Area	Day of waste generation			
	Thursday	Friday	Saturday	Sunday
(3) South Fork Campground				
Pounds of waste generated	61	48	31	45
Visitor days contributing	68.9	49.1	84.6	53.2
Pounds/visitor day	0.89	0.98	0.37	0.85
Camper days contributing	42	15	27	37
Pounds/camper day	1.45	3.20	1.15	1.22
Composition (percent)				
Food wastes	46.6	26	35.3	22.3
Other combustibles	36.6	36	35.3	40.0
Noncombustibles	16.8	38	29.4	37.7
(4) Beaver Creek Campground				
Pounds of waste generated	70	76	40	73
Visitor days contributing	117.8	229.5	141.3	110.3
Pounds/visitor day	0.59	0.33	0.28	0.66
Camper days contributing	41	37	44	45
Pounds/camper day	1.71	2.05	0.91	1.62
Composition (percent)				
Food wastes	31.3	33.3	28.5	30.1
Other combustibles	28.7	38.1	43.0	36.8
Noncombustibles	40.0	28.6	28.5	33.1
(5) Beaver Creek Organization Camp				
Pounds of waste generated	57	94	219	0
Occupant days contributing	60.0	60.0	64.0	0.0
Pounds/occupant day	0.95	1.57	3.42	
Composition (percent)				
Food wastes	65	54	51	–
Other combustibles	18	31	34	–
Noncombustibles	17	15	15	–

* All percents by weight.

SOLID WASTE STUDY, AUGUST 13 – SEPTEMBER 2, 1968

WAYNE–HOOSIER NATIONAL FOREST, OHIO

SITES STUDIED:

Iron Ridge Campground (1)
Oak Hill Campground (2)
Vesuvius Family (3) and Group (4) Picnic Area and Job Corps Civilian Conservation Center (7)
Big Bend Beach Area (5)
Big Bend Beach Concession Stand (6)

PERSONNEL:

Study Team: Charles S. Spooner, Harry R. Little, Howard R. Ludwig, and F. Owen Irvine, BSWM, ECA.

WAYNE–HOOSIER NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
(1) Iron Ridge Campground							
(first week)							
Pounds of waste generated	–	72.1	78.8	92.6	100.9	131.1	149.9
Visitor days contributing	–	62.0	78.3	116.5	127.0	175.0	106.8
Pounds/visitor day	–	1.16	1.00	0.79	0.79	0.75	1.40
Camper days contributing	–	52	55	87	106	98	96
Pounds/camper day	–	1.39	1.43	1.06	0.95	1.34	1.56
(second week)							
Pounds of waste generated	101.3	62.1	64.9	67.8	89.4	67.0	115.2
Visitor days contributing	61.3	62.8	69.9	63.6	71.9	76.3	84.2
Pounds/visitor day	1.65	0.99	0.93	1.07	1.24	0.88	1.37
Camper days contributing	55	42	52	46	55	66	70
Pounds/camper day	1.84	1.48	1.25	1.47	1.62	1.02	1.64
(third week)							
Pounds of waste generated	47.9	80.6	59.4	112.3	108.5	247.1	200.2
Visitor days contributing	64.4	93.9	95.0	93.3	142.7	193.0	206.5
Pounds/visitor day	0.74	0.86	0.63	1.20	0.76	1.28	0.97
Camper days contributing	54	76	67	67	120	123	122
Pounds/camper day	0.89	1.06	0.89	1.68	0.90	2.01	1.64

WAYNE–HOOSIER NATIONAL FOREST – CONTINUED

Area	Day of waste generation						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
(2) Oak Hill Campground							
(first week)							
Pounds of waste generated	–	122.5	56.3	112.6	68.8	121.8	109.0
Visitor days contributing	–	98.4	98.8	83.3	86.2	140.5	88.8
Pounds/visitor day	–	1.24	0.56	1.35	0.80	0.87	1.23
Camper days contributing	–	63	76	65	53	95	71
Pounds/camper day	–	1.94	0.74	1.73	1.30	1.28	1.54
(second week)							
Pounds of waste generated	86.1	80.2	205.2	139.6	148.1	120.3	111.8
Visitor days contributing	104	120.1	133.8	104.8	110.8	128.8	112.3
Pounds/visitor day	0.83	0.67	1.53	1.33	1.34	0.93	1.00
Camper days contributing	83	97	98	96	96	89	96
Pounds/camper day	1.04	0.83	2.09	1.45	1.54	1.35	1.16
(third week)							
Pounds of waste generated	86.1	61.0	60.0	75.7	66.9	110.3	211.3
Visitor days contributing	106.6	67.3	85.5	90.8	126.5	170.2	163.6
Pounds/visitor day	0.81	0.91	0.70	0.83	0.53	0.63	1.29
Camper days contributing	68	53	54	79	100	109	112
Pounds/camper day	1.27	1.15	1.11	0.96	0.67	1.01	1.89
	Date of waste generation						
(3) Vesuvius Family Picnic Area		8/13	8/15	8/16	8/17	8/18	8/19
Pounds of waste generated		14.8	3.9	28.1	17.3	117.3	34.5
Picnickers contributing		15	7	17	43	149	52
		8/20	8/21	8/22	8/23	8/24	8/25
Pounds of waste generated		15.0	22.5	28.4	26.2	36.5	155.4
Picnickers contributing		38	37	53	31	33	128
		8/26	8/27	8/28	8/29	8/30	8/31
Pounds of waste generated		2.5	7.0	14.3	9.7	14.7	24.1
Picnickers contributing		9	11	14	5	22	35
		9/1	9/2				
Pounds of waste generated		93.4	122.8				
Picnickers contributing		131	121				

WAYNE–HOOSIER NATIONAL FOREST – CONTINUED

Area	Date of waste generation						
(4) Vesuvius Group Picnic Area	8/18	8/20	8/24	8/25	8/29	8/31	9/2
Pounds of waste generated	188.5	25.3	14.7	130.0	132.8	45.6	41.8
Picnickers contributing	130	35	15	120	68	75	38
Average composition (percent*)							
Food wastes	41†						
Other combustibles	21†						
Noncombustibles	38†						

(5) Big Bend Beach Area

The Big Bend Beach Area is a swimming area with a snack bar. During the study, 7,382 swimmers were counted. The study team gathered 262.0 lb of solid waste, at an average rate of 0.04 lb per swimmer.

(6) Big Bend Beach Concession Stand

During the study, 961 concession–stand patrons, not swimming, generated 135.6 lb of solid waste. They averaged 0.14 lb per patron, with a standard deviation of 0.16 lb per patron.

	Wednesday	Friday
(7) Vesuvius Job Corps Civilian Conservation Center		
Kitchen wastes:		
Pounds of waste generated	409.3	310.5
Corpsman days contributing	176	166
Pounds/corpsman day	2.32	1.87
Composition (percent)		
Food wastes	73.5	77.4
Other combustibles	10.0	22.6
Noncombustibles	16.5	0.0
Administrative and dormitory wastes:		
Pounds of waste generated	98.8	27.3
Corpsman days contributing	176	166
Pounds/corpsman day	0.56	0.16
Composition (percent)		
Combustibles	78	100
Noncombustibles	22	0
Maintenance shops wastes:		
Pounds of waste collected	212.8	78.0
Days of activity contributing	2	2
Pounds/day	106.4	39.0
Composition (percent)		
Combustibles	94	100
Noncombustibles	6	0

* All percents by weight.

† Total of 7 days.

SOLID WASTE STUDY, FEBRUARY 28 — MARCH 7, 1969

WINTER SPORTS AREA
CACHE NATIONAL FOREST, UTAH

SITES STUDIED:

Gelande Lodge (1)
Ski Lift Area (2)
Hill Air Force Base Lodge (3)

PERSONNEL:

Study Team: Walter S. Weaver and Richard H. Spray, SDEDC, USFS.
Local Staff: Floyd Ingram, Region 4, FS; and Bruce Hronek, Ogden RD, and Preston Jackson, Snow Ranger, Snow Basin Ski Area, Cache NF.

CACHE NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Date of waste generation				
(1) Gelande Lodge*	2/28	3/1	3/2	3/5	3/6
Pounds of waste generated	62	130	119	85	50
Visitor days contributing	25.0	44.0	56.0	23.0	5.7
Pounds/visitor day	2.48	2.95	2.13	3.70	8.77
Composition (percent†)					
Food wastes	14.6	11.6	21	23.5	34
Other combustibles	54.8	67.6	63	56.5	56
Noncombustibles	30.6	20.8	16	20.0	10
(2) Ski Lift Area		3/1	3/2	3/5	3/6
Pounds of waste generated		19	25	17	19
Visitor days contributing		–	–	–	–
Composition (percent)					
Food wastes		0.0	0	5.9	0.0
Other combustibles		78.9	41	41.2	68.4
Noncombustibles		21.1	59	52.9	31.6
(3) Hill Air Force Base Lodge	2/28	3/1	3/2		
Pounds of waste generated	41	60	46		
Visitor days contributing	45.0	53.0	17.0		
Pounds/visitor day	0.91	1.13	2.71		
Composition (percent)					
Food wastes	0.0	13.3	4.4		
Other combustibles	73.2	65.0	73.9		
Noncombustibles	26.8	21.7	21.7		

* Day use.
† All percents by weight.

SOLID WASTE STUDY, FEBRUARY 28 – MARCH 7, 1969

WINTER SPORTS AREA
WASATCH NATIONAL FOREST, UTAH

SITES STUDIES:

Rustler Lodge (1)
Alta Lodge (2)
Snow Pine Lodge (day use) (3)
Shallow Shaft Tavern (4)

PERSONNEL:

Study Team: Walter S. Weaver and Richard H. Spray, SDEDC, FS
Local Staff: Floyd Ingram, Region 4, FS; and Ames Harrison, Salt Lake RD, Wasatch NF.

WASATCH NATIONAL FOREST

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation						
	Fri	Sat	Mon	Tues	Wed	Thurs	Fri
(1) Rustler Lodge							
Pounds of waste generated	134	178	209	195	365	205	167
Visitor days contributing	113	111	126	108	113	115	100
Pounds/visitor day	1.19	1.60	1.66	1.81	3.23	1.78	1.67
Composition (percent*)							
Food wastes	35.0	54.5	64.1	57.5	51.2	40.0	42.5
Other combustibles	36.6	12.4	20.6	24.6	39.2	35.1	35.3
Noncombustibles	28.4	33.1	15.3	17.9	9.6	24.9	22.2
(2) Alta Lodge							
Pounds of waste generated					1818†	242	276
Visitor days contributing					858	180	165
Pounds/visitor day					2.12	1.34	1.67
Composition (percent)							
Food wastes					27.4	23.6	12.7
Other combustibles					29.1	42.2	50.0
Noncombustibles					43.5	34.2	37.3
(3) Snow Pine Lodge‡							
Pounds of waste generated	80	14	13.5	21			
Visitor days contributing	24.0	4.7	5.8	8.4			
Pounds/visitor day	3.33	2.98	2.33	2.50			
Composition (percent)							
Food wastes	8.7	35.7	0	0.0			
Other combustibles	60.0	35.7	37	52.3			
Noncombustibles	31.3	28.6	63	47.7			

GENERATION AND COMPOSITION OF SOLID WASTE

Area	Day of waste generation Fri	Sat	Mon	Tue	Wed	Thurs	Fri
(4) Shallow Shaft Tavern							
Pounds of waste generated	32	12	16	9			
Visitor days contributing	8.4	8.3	12.5	2.9			
Pounds/visitor day	3.81	1.46	1.28	3.10			
Composition (percent)							
Food wastes	0.0	0.0	0.0	0.0			
Other combustibles	40.6	33.3	31.3	44.4			
Noncombustibles	59.4	66.7	68.7	55.6			

* All percents by weight.

† Wastes collected on Wednesday had accumulated since Friday.

‡ Day use.

APPENDIX 3

VARIATIONS IN THE WASTE GENERATION RATE AND IN WASTE COMPOSITION

Data from 23 campgrounds were analyzed in an effort to explain the variation encountered in waste composition and in the total weight generated per person.

Data from 19 of the campgrounds included information on waste composition as well as total waste generation rates encountered on each of 4 study days. In the other four campgrounds, the total waste generation rate was measured for each of the 4 days, and data from two of these four campgrounds consisted of total waste generation rates for three separate Thursday–through–Sunday intervals.

Each campground was developed to level three or four (Appendix 1) and received either predominantly overnight use or use as a recreation destination for campers planning extended stays. (The data for all analyses are shown in Table A3-1.)

Seven analyses of variance were conducted on the data arranged in different ways. A confidence level of 90 percent was used in each analysis. To satisfy the basic assumption made in the analysis of variance (ANOVA) that the variances are homogeneous (i.e., that the sources of variance in waste generation rates are essentially the same and that the variances in the population of all campgrounds are equal), a square root transform was used on the data before analysis. All work was done on an IBM 1130.

Waste Generation Rates

To detect regional variations in waste generation rates, the first analysis sought to determine statistically significant variation in the daily mean of the total waste generated per person in 24 campgrounds.

The ANOVA showed that at least one mean was significantly different from the other means. The least significant differences (LSD's) were computed to locate the statistical differences the ANOVA selected. (The LSD is used to compare daily means of the total solid waste generated per person. The LSD value is split and half its value added to and half subtracted from the data means. If the length of two or more bands of the LSD overlap, the means at their center are not considered statistically different. Bands that do not overlap others are considered significantly different. LSD's are usually applied only after an F test in an ANOVA has shown that differences existed somewhere between the means.) The LSD revealed the data from Hot Springs to be significantly different from the other campground data. When the data were rechecked, Hot Springs was disqualified as a valid data point because of poorly controlled recreation use measured during the study. A second ANOVA, which excluded Hot Springs data and used data from 23 campgrounds, revealed no significant difference among the waste generation rates in those campgrounds. Both analyses revealed no significant difference among the daily mean waste generation rate on the 4 study days.

Fifteen campgrounds judged to receive use as a camper's destination were considered separately. An ANOVA was conducted to detect whether the daily mean of the total waste generation rate varied significantly among the campgrounds and among the days of the studies. The conclusions differed from those reached when all campgrounds were considered. In this analysis, the day on which the wastes were generated proved significant, and the campground generating the waste proved nearly significant. The LSD's revealed that waste quantities generated on Thursday, Friday, and Saturday were significantly different from those waste quantities generated on Sunday (Figure A3–1). The developmental level (three or four) of the destination campground also proved significant.

"Destination" campgrounds were considered again with further subdivision to detect the extent of the differences among their development levels. The eight destination campgrounds developed to level three were considered separately for differences in total waste generation. Neither the campground nor the day of waste generation proved significant.

When the seven "destination" campgrounds developed to level four were considered, the campground generating the waste was not significant but the day on which the wastes were generated proved to be. The LSD's for this ANOVA showed that wastes generated on Friday were significantly different from wastes generated on both Saturday and Sunday (Figure A3-2).

Analysis of total waste generation rate data from campgrounds judged to receive overnight use developed to level three revealed no statistically significant differences among the campgrounds or the day on which the wastes were generated. Hence, all significant variation among destination campgrounds was caused by the fraction developed to level four.

Waste Composition

Three factors of waste composition were analyzed from 19 campgrounds: the day on which the wastes were generated, the type of waste (food waste, other combustibles, noncombustibles), and the campground from which they came.

When the LSD's considered the three waste components for the 4 study days, the wastes generated on Sundays were found to differ significantly from those generated on Saturdays (Figure A3–3).

The distribution of means for three individual waste types reveals no regional trends (Figures A3–4 through A3–6). One campground, (Samowen) where campsite burning of some combustibles was encouraged, showed significantly fewer combustibles (other than food wastes) than did most other campgrounds.

TABLE A3–1

DATA USED TO DETECT VARIATION IN THE WASTE GENERATION RATE

Forest	Campground	Scale of development (Appendix 1)	Overnight (O) or destination (D) campground	Waste categories: FW=Food waste OC=Other combustibles NC=Noncombustibles T=Total	Days of waste generation			
					Thur.	Fri.	Sat.	Sun.
					Waste (lb/camper day)			
Allegheny	Kiasutha	4	D	FW	0.46	0.27	0.59	0.54
				OC	0.23	0.26	0.51	0.35
				NC	0.27	0.19	0.35	0.39
				T	0.96	0.73	1.45	1.28
	Buckaloons	3	D	FW	0.22	0.28	0.55	0.41
				OC	0.26	0.19	0.32	0.25
				NC	0.48	0.32	0.47	0.46
				T	0.96	0.79	1.33	1.13
Deschutes	Prairie	3	O	FW	0.18	0.30	0.08	2.00
				OC	0.23	0.27	0.14	1.07
				NC	0.29	0.40	0.25	1.79
				T	0.70	0.97	0.47	4.86
	Paulina Lake	4	D	FW	0.75	0.31	0.39	0.52
				OC	0.54	0.16	0.33	0.51
				NC	0.41	0.31	0.41	0.61
				T	1.70	0.80	1.13	1.64

TABLE A3–1 – CONTINUED

Forest	Campground	Scale of development (Appendix 1)	Overnight (O) or destination (D) campground	Waste categories: FW=Food waste OC=Other Combustibles NC=Noncombustibles T=Total	Days of waste generation			
					Thur.	Fri.	Sat.	Sun.
					Waste (lb/camper day)			
Deschutes (continued)								
	East Lake	4	D	FW	0.63	0.30	0.37	0.81
				OC	0.38	0.28	0.33	0.38
				NC	0.44	0.22	0.38	0.79
				T	1.45	0.80	1.09	1.98
	Cinder Hill	4	D	FW	0.34	0.24	0.49	0.68
				OC	0.42	0.34	0.42	0.72
				NC	0.37	0.31	0.55	0.72
				T	1.13	0.89	1.46	2.24
	Princess Creek	3	D	FW	0.50	0.41	0.38	0.60
				OC	0.60	0.32	0.30	0.43
				NC	0.39	0.20	0.22	0.32
				T	1.49	0.93	0.90	1.35
	Trapper Creek	3	D	FW	0.71	0.46	0.39	0.57
				OC	0.57	0.31	0.31	0.46
				NC	0.64	0.23	0.26	0.47
				T	1.92	1.01	0.96	1.50
Eldorado	Fallen Leaf	3	O	FW	0.18	0.29	0.31	0.38
				OC	0.31	0.36	0.34	0.44
				NC	0.32	0.36	0.43	0.29
				T	0.81	1.01	1.08	1.11
Gallatin	Bakers Hole	3	O	FW	0.28	0.22	0.23	0.25
				OC	0.25	0.16	0.21	0.12
				NC	0.28	0.18	0.22	0.21
				T	0.81	0.56	0.66	0.58
	Beaver Creek	3	O	FW	0.71	1.29	0.68	1.78
				OC	0.67	0.76	0.58	0.98
				NC	1.08	1.01	0.98	1.81
				T	2.46	3.06	2.24	4.57
Huron–Manistee	Sand Lake	4	D	FW	0.18	0.31	0.74	0.34
				OC	0.14	0.16	0.26	0.17
				NC	0.21	0.26	0.39	0.23
				T	0.53	0.73	1.39	0.74
Kaniksu	Samowen	4	D	FW	0.36	0.21	0.47	0.56
				OC	0.09	0.17	0.11	0.13
				NC	0.55	0.40	0.35	0.43
				T	1.03	0.76	0.93	1.12

TABLE A3–1 – CONTINUED

Forest	Campground	Scale of development (Appendix 1)	Overnight (O) or destination (D) campground	Waste categories: FW=Food waste OC=Other Combustibles NC=Noncombustibles T=Total	Days of waste generation Thur.	Fri.	Sat.	Sun.
					Waste (lb/camper day)			
Lincoln	Deerhead	3	O	T	1.50	1.82	1.91	3.23
	Sleepy Grass	3	O	T	0.67	1.36	1.72	3.40
Ozark	Cove Lake	3	D	FW	0.46	1.06	0.92	1.30
				OC	0.45	0.77	0.45	0.46
				NC	0.32	0.48	0.36	0.40
				T	1.23	2.31	1.73	2.16
	Spring Lake	3	D	FW	0.57	0.28	0.35	0.54
				OC	0.43	0.39	0.39	0.43
				NC	0.43	0.55	0.40	0.48
				T	1.43	1.22	1.14	1.45
Rio Grande	Palisade	3	O	FW	0.52	0.72	0.35	0.24
				OC	0.39	1.39	0.52	0.33
				NC	0.42	1.82	0.35	0.46
				T	1.37	3.93	1.22	1.03
	Beaver Creek	3	D	FW	0.53	0.69	0.26	0.49
				OC	0.49	0.78	0.39	0.59
				NC	0.68	0.59	0.26	0.55
				T	1.71	2.05	0.91	1.62
	South Fork	3	O	FW	0.68	0.83	0.41	0.27
				OC	0.53	1.15	0.41	0.49
				NC	0.24	1.22	0.34	0.46
				T	1.45	3.20	1.15	1.22
	Big Meadows	3	D	FW	0.54	1.11	0.21	0.69
				OC	0.60	0.95	0.37	0.88
				NC	0.37	0.84	0.30	0.69
				T	1.50	2.90	0.87	2.25
Wayne–Hoosier	Oak Hill (A)*	4	D	T	1.73	1.30	1.28	1.54
	Oak Hill (B)			T	1.45	1.54	1.35	1.16
	Oak Hill (C)			T	0.96	0.67	1.01	1.89
	Iron Ridge (A)	3	D	T	1.06	0.95	1.34	1.56
	Iron Ridge (B)			T	1.47	1.62	1.02	1.64
	Iron Ridge (C)			T	1.68	0.90	2.01	1.64

* A, B, and C denotes three Thursday–through–Sunday periods on which data were collected.

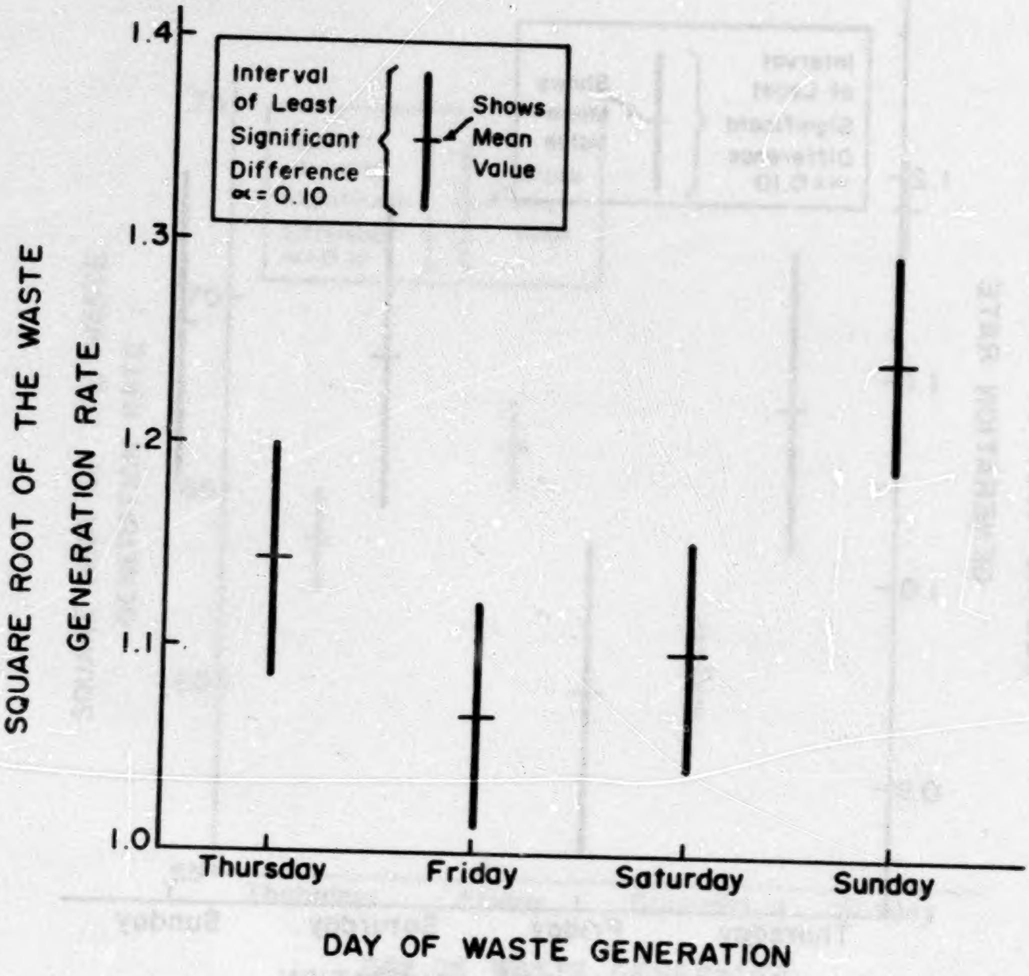

Figure A3–1. Comparison of means of day of waste generation at 15 destination campgrounds.

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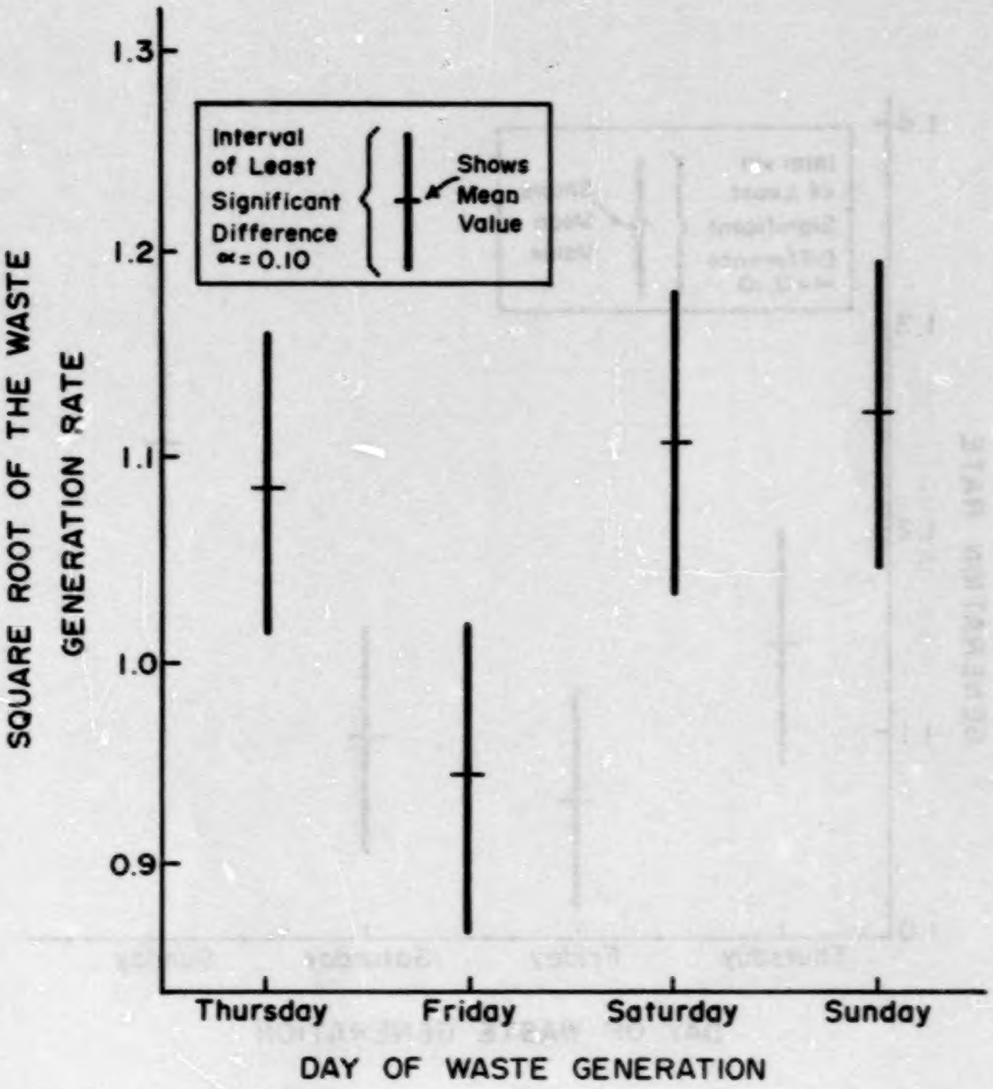

Figure A3–2. Comparison of means of day of waste generation at seven level–four campgrounds.

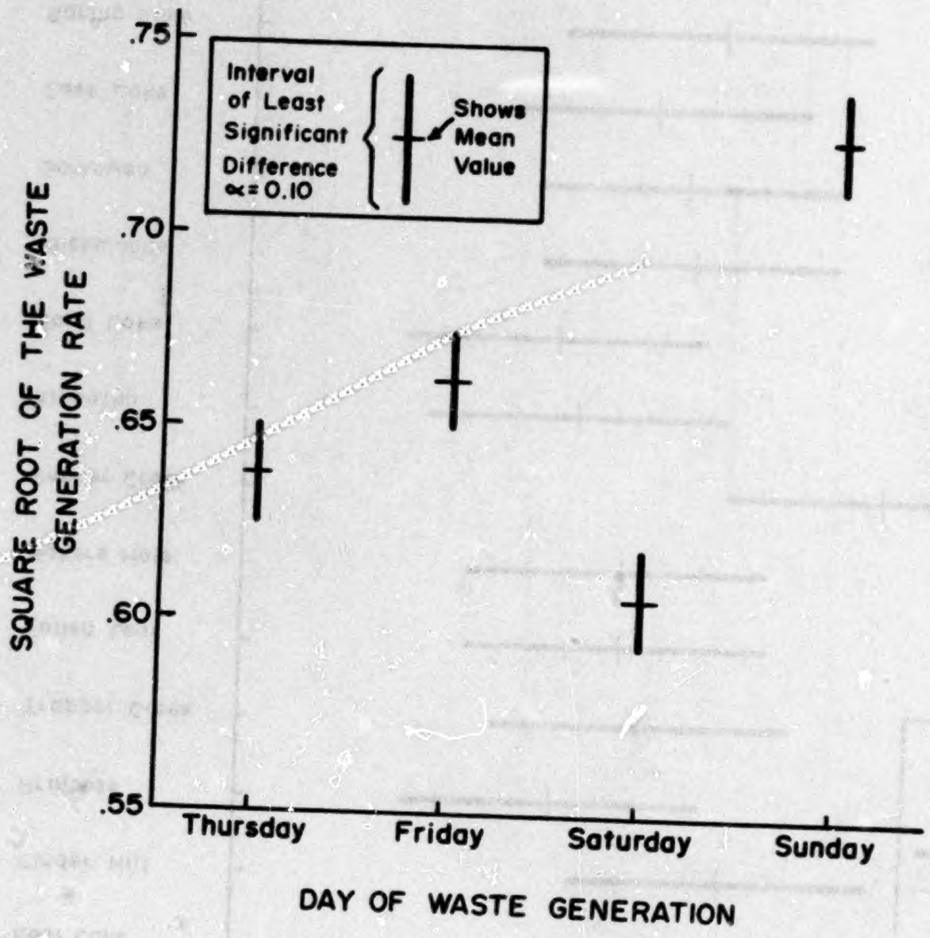

Figure A3–3. Comparison of means of day of waste generation at 19 campgrounds studied.

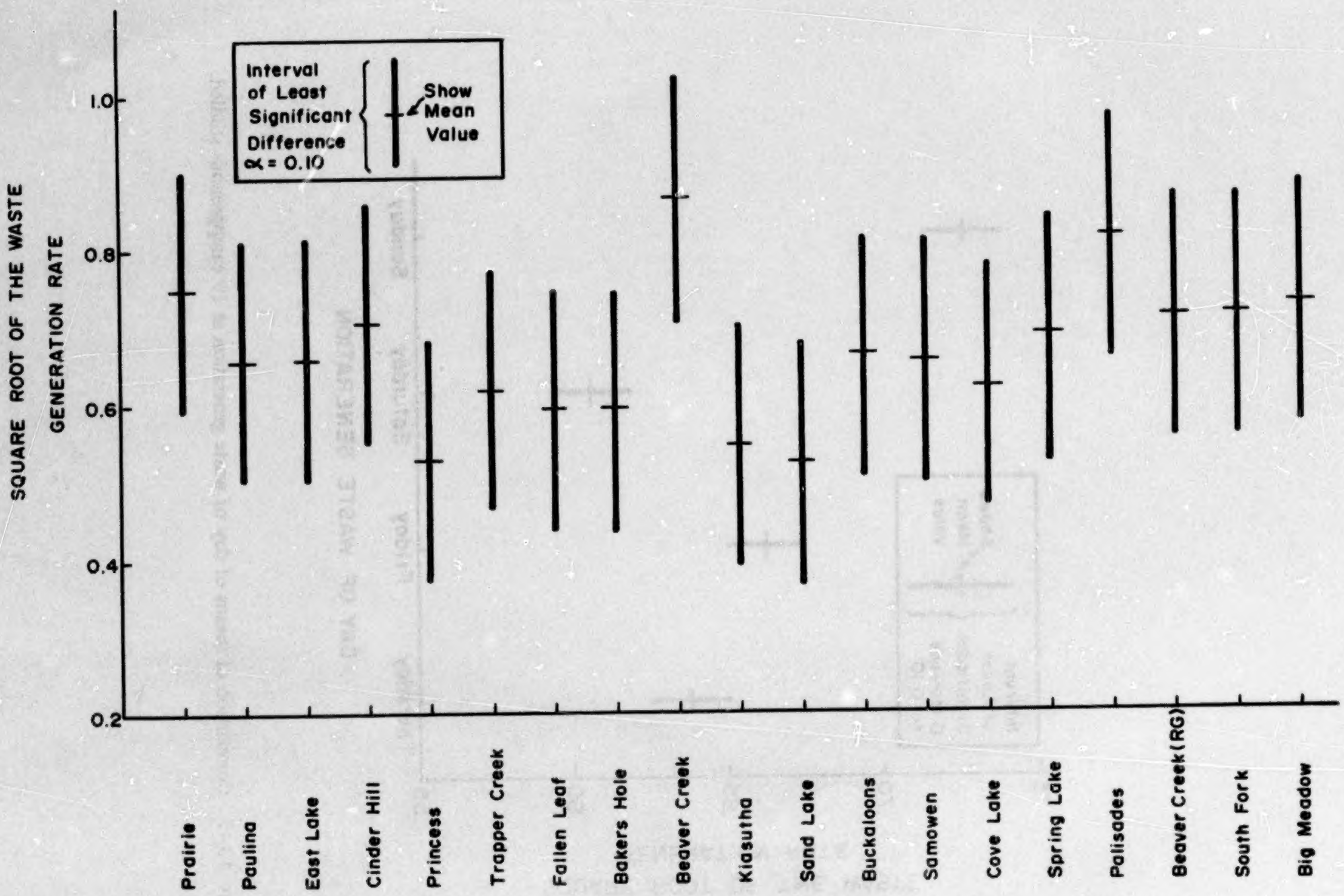

Figure A3–4. Comparison of means of noncombustible solid waste for 19 campgrounds.

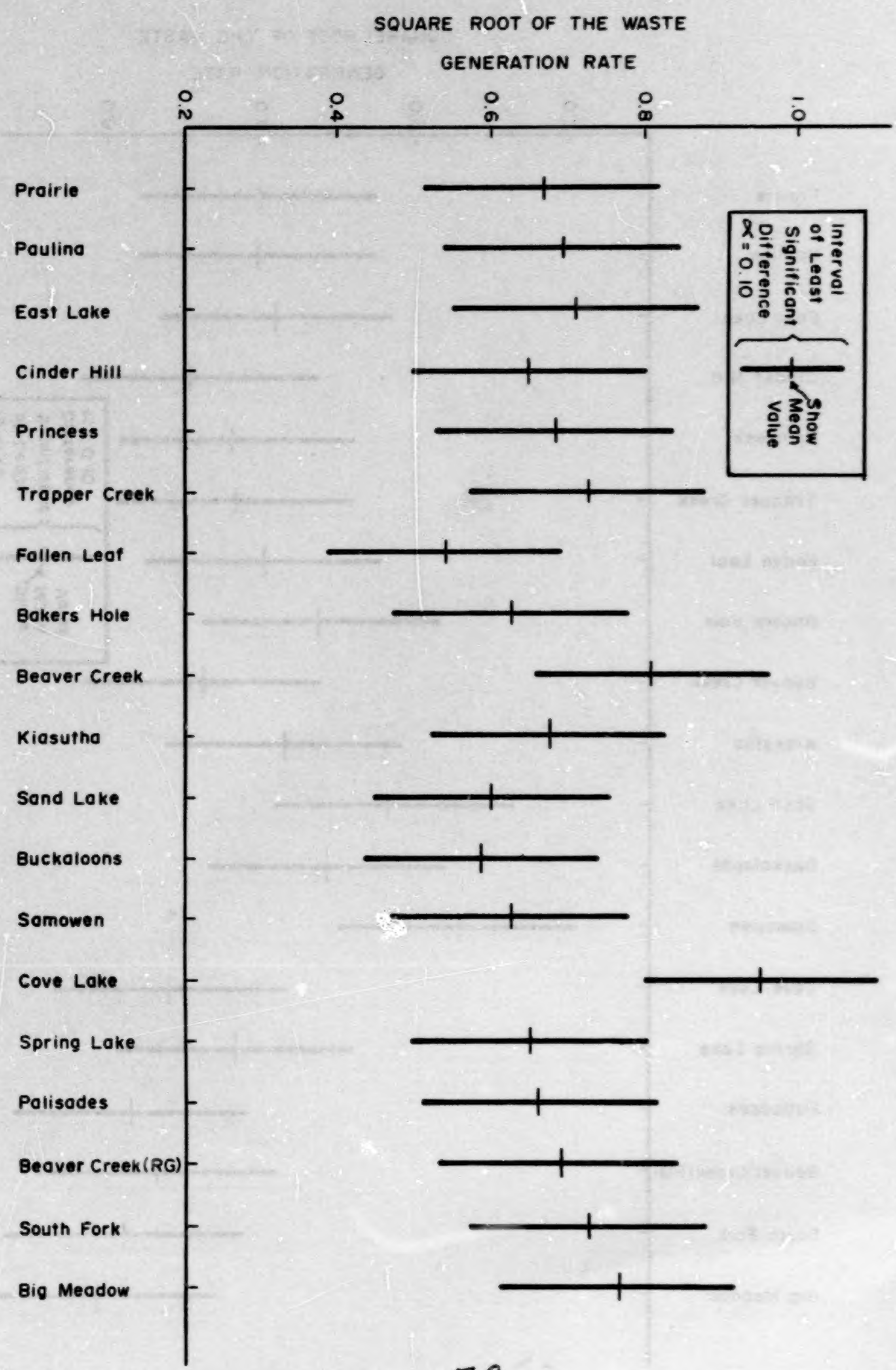

Figure A3–5. Comparison of means of food waste for 19 campgrounds.

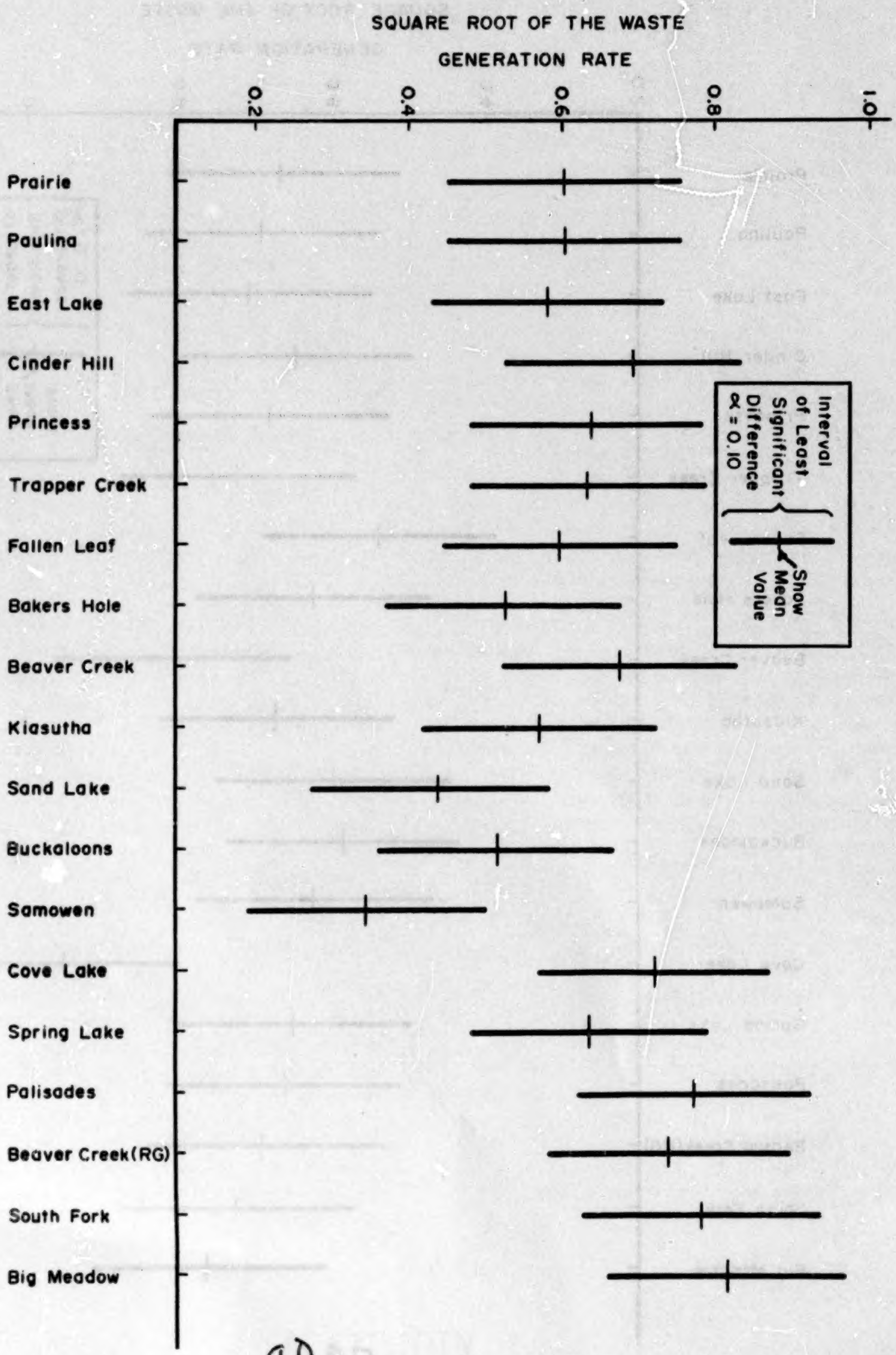

Figure A3–6. Comparison of means of combustible solid waste from 19 campgrounds.

APPENDIX 4

COSTS OF SOLID WASTE COLLECTION

Interviews conducted in 22 Districts in 15 Forests provided descriptions of 28 separate collection systems. Collection systems were privately operated, on contract, for seven of these Districts.

For this analysis, a collection system was defined as one where collection costs and recreation use could be defined for the same time period. Private service to a single recreation area for an entire season and well–described Forest Service collection to several recreation areas for portions of a season provided necessary data.

Data used in the analysis are reproduced in Table A4–1. Total handling costs, as described in the text, were the sum of costs of manpower, container liners, vehicle use and mileage, and disposal.

The use figures (columns 4 through 9 on Table A4–l) were taken from district RIM printouts. District estimates were used to assign the fraction of the total use that occurred during the period for which collection–cost figures were available.

A stepwise regression analysis was computed on an IBM 1130. The variables (columns 3 through 9) were considered in the order of their contribution to the total costs. The most significant variable was first entered; then the first and second variables together; then the first three together, and so on. The one variable that contributed most to the total cost (total collection route miles traveled) explained 68 percent of the variation in the data; the best three variables together explained 81 percent of the variation. Since other variables did not increase this percentage appreciably, only three variables were used in the final equation:

$$C = 0.77\ RM + 1.13\ PAOT + 27.6\ PVD - 403$$

where C = Total solid waste handling cost for the time period considered, in dollars,

RM = Collection route miles traveled during the time period considered including distance to dispoal site,

PAOT = Capacity of the campgrounds in number of campers

PVD = Thousands of picnicker visitor–days incurred over the time period considered.

This equation will be of little use over short time periods or in Districts with an unbalanced mixture of recreation use. If a preponderance of recreation activities are those not considered by the equation, error will also result. Picnicking and camping were considered because they contribute the most waste, but the equation covers the cost of all collection service. Pay increases to Forest workers will increase the coefficient in the equation; reduced crew sizes will lower it.

The Districts surveyed spent an average of less than 4 percent of their total solid waste handling costs on disposal. In the future when this fraction is increased, the equation should be revised.

The precision of the equation is illustrated by Figure A4–1 where predicted and actual values of "C" are plotted together. Statistically, the equation possesses a standard error of 46.3 percent of the average "C" for all districts. This equation should not be used to predict costs when the merits of private collection contracts are evaluated.

Another, perhaps more important, use of the equation has been noted in the report text (p. 25). It shows that the total number of route miles (because of the manpower required) is the most significant cause of cost, and that reducing the miles traveled will reduce costs.

TABLE A4–1

DATA USED TO COMPUTE FORMULA PREDICTING SOLID WASTE COLLECTION COSTS

Data number	Total handling cost ($)	Total route (miles)	Camper visits (thousands)	Campground capacity	Camping visitor days (thousands)	Picnicker visits (thousands)	Picnic–ground capacity	Picnic visitor days (thousands)
1	$1,367	990	8.4	555	7.4	4.5	178	1.1
2	1,000	1,210	63.5	555	58.8	4.2	105	1.4
3	767	2,970	2.1	295	12.2	5.9	195	2.1
4	1,734	1,536	7.6	185	13.9	2.6	40	4.9
5	901	4,256	6.4	395	16.2	0.9	150	0.4
6	1,500	840	71.2	45	71.8	–	–	–
7	574	1,350	12.4	230	9.3	16.0	100	4.0
8	1,168	4,050	24.0	195	25.6	–	–	–
9	2,066	3,612	9.5	25	4.2	24.0	65	3.1
10	6,560	6,500	154.0	495	47.4	2.1	700	32.1
11	4,714	3,840	20.9	75	15.5	4.8	265	7.2
12	9,434	5,525	108.0	3,546	95.6	–	–	–
13	1,451	812	24.5	355	14.9	5.6	95	2.2
14	2,477	2,940	3.4	475	10.9	7.9	600	2.0
15	409	800	1.2	25	1.8	13.2	315	3.4
16	768	1,015	37.9	235	26.0	3.4	128	1.0
17	6,566	4,620	99.0	740	58.3	16.7	135	4.6
18	1,903	2,364	17.7	75	8.3	17.2	465	39.1
19	559	645	9.1	200	5.0	1.4	60	0.7

TABLE A4–1 – CONTINUED

Data number	Total handling cost ($)	Total route (miles)	Camper visits (thousands)	Campground capacity	Camping visitor days (thousands)	Picnicker visits (thousands)	Picnic–ground capacity	Picnic visitor days (thousands)
20	2,793	2,580	63.0	455	25.3	–	–	–
21	843	975	26.6	885	15.6	15.3	155	0.5
22	$5,220	4,000	339.0	3,509	137.0	29.9	460	7.7
23	6,952	7,000	46.0	1,670	97.8	36.4	159	5.9
24	1,101	1,050	3.9	200	6.6	7.1	220	7.6
25	976	2,057	5.9	150	6.9	18.7	120	4.9
26	130	273	4.4	65	3.4	4.9	95	1.9
27	595	1,953	3.4	90	0.5	10.2	120	2.6
28	4,761	5,000	12.0	480	25.4	14.2	500	15.7

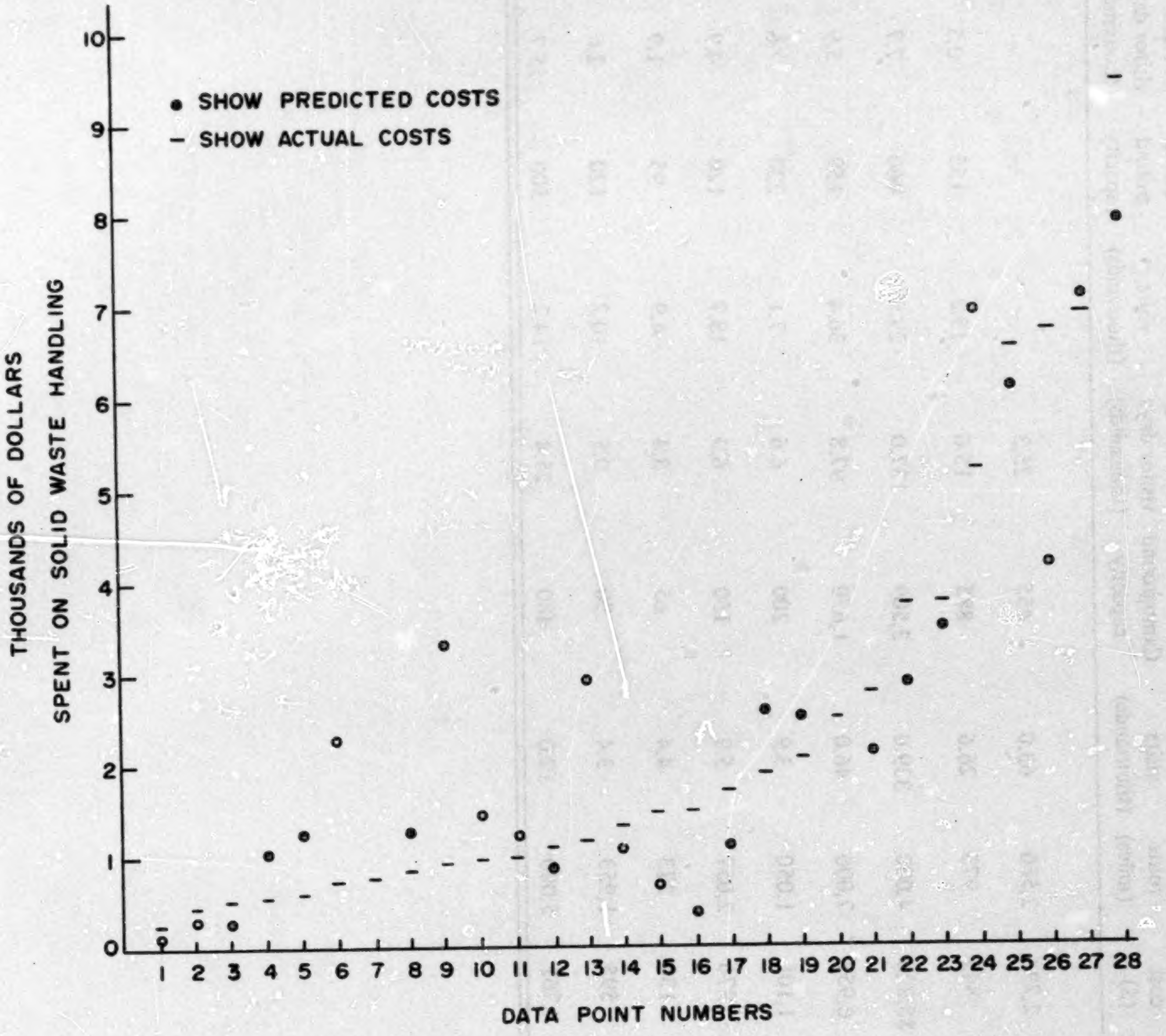

Figure A4–1. Total handling costs predicted by the regression equation (arranged in ascending order of actual costs).

APPENDIX 5

SOLID WASTE MANAGEMENT
COST QUESTIONNAIRE

Data reference No. ____________

Region ____________ Forest ____________ District ____________

Person interviewed ____________ Position ____________

Interviewer____________ Date ____________

1. The major recreation–use season is from ____________ to ____________ ____________ (months or dates), and ________% of the year's total use occurs during this period.

2. Solid waste containers:

   a. Are bulk (larger than 35 gallons) containers used? ____________ Where? ____________

   b. Are plastic or kraft paper liners used? ____________

3. Is the on–site burning of combustible portions of camping and picnicking waste encouraged? ________ ____________ Practiced? ____________

4. What are the days of scheduled solid waste collection for each of the following?

Circle appropriate items.

Area	Collection Days	Collector
____________	S M T W T F S	F S Contract
____________	S M T W T F S	F S Contract
____________	S M T W T F S	F S Contract
____________	S M T W T F S	F S Contract
____________	S M T W T F S	F S Contract
____________	S M T W T F S	F S Contract

I. Private Collection

a. Extent of private collection ____________________

b. Duties of contractor other than solid waste collection ____________________

____

c. Annual cost of Forest–Service–furnished supplies for private solid waste collection:

Item	Cost

d. If contract for solid waste collection are let to bidder, what have been the trends in contract costs?

____

____

____

____

II. Forest Service Collection

a. Extent of Forest Service collection ____________________

____

b. Manpower assigned to the task

No. of men	Classification	Man days spent on collection

c. Equipment assigned to the task (identify in W.C.F. Catalog)

____

d. Supplies expended on Forest Service solid waste collection

Item	$/ ________

III. Disposal

a. Disposal sites

Site	Type	User	Operator	Cost $/____	Frequency of use or cover

b. Costs incurred by Forest Service in disposal

Equipment:

Item	W.C.F. designation	Time equipment is comitted to solid waste disposal

Personnel:

No.	Classification on disposal	Man days spent

Notes and comments:

TABLE A5–1

SUMMARY FROM THE SOLID WASTE MANAGEMENT COST QUESTIONNAIRE

Forest	District	Collector	Total solid waste handling cost*	Cost* of plastic liners	Cost* of FS manpower	Cost* of FS truck rental	Cost* of FS mileage	Cost* of dis–posal	Total route miles	Camp–ground capa–city	Camping–visitor–days (thou–sands)	Picnic ground capa–city	Picnic visitor–days (thou–sands)
Allegheny	Bradford	FS	2,477	455	1,512	64	235	210	2,940	475	10.9	600	2.0
	Sheffield	FS	1,903	220	1,398	58	118	110	2,364	75	8.3	465	39.1
		Private	559	–	–	–	–	–	645	200	5.0	60	0.7
Ashley	Manilla	FS	9,434	1,458	6,237	1,305	233	200	5,525	3,546	95.6	0	0
	Vernal	FS	1,451	110	909	196	37	200	812	355	14.9	95	2.2
Deschutes	Fort Rock	FS	6,952	575	5,073	200	400	704	7,000	1,670	97.8	159	5.9
Eldorado	Lake Valley	FS	5,220	1,200†	2,938	110	924	–	4,000	3,509	137.0	460	7.7
Gallatin	Hebgen Lake	FS	6,566	110	5,548	136	508	264	4,620	740	58.3	135	4.6
Georgia	Redlands	FS	2,066	60	1,673	44	289	0	3,612	25	4.2	65	3.1
	Uncle Remus	FS	4,714	110	3,624	498	481	0	3,840	75	15.5	265	7.2
Huron–Manistee	Manistee	Private	843	500	283	22	39	–	975	885	15.6	155	0.5
Kaniksu	Sandpoint	FS	409	22	173	30	174	60	800	25	1.8	315	3.4
	Clark Fork	FS	768	70	380	216	53	50	1,015	235	26.0	128	1.0
Lincoln	Cloudcroft	FS	4,761	220	4,037	96	322	87	5,000	480	25.4	500	15.7
Mississippi	Strong River	FS	1,101	105	895	27	73	0	1,050	200	6.6	220	7.6
Nicolet	Lakewood	FS	1,367	660	449	172	25	60	990	555	7.4	178	1.1
		Private	1,000	–	–	–	–	–	1,210	555	58.8	105	1.4
North Carolina	Wayah	FS	574	198	175	37	92	72	1,350	230	9.3	100	4.0
		Private	1,168	–	–	–	–	–	4,050	195	25.6	0	0
	Pisgah	FS	6,560	800	4,824	398	540	0	6,500	495	47.4	700	32.1
Ozark	Mt. Magazine	Private	976	–	–	–	–	390	2,057	150	6.9	120	4.9
		Private	130	–	–	–	–	–	273	65	3.4	95	1.9
		Private	595	–	–	–	–	–	1,953	90	0.5	120	2.6
Rio Grande	Alder	FS	2,793	28	2,570	57	139	0	2,580	455	25.3	0	0
Superior	Aurora	FS	767	55	544	19	148	0	2,970	295	12.2	195	2.1
	Isabella	FS	1,734	99	1,459	53	123	0	1,536	185	13.9	40	4.9
	Kawishiwi	FS	901	168	616	34	85	27	4,256	395	16.2	150	0.4
		Private	1,500	–	–	–	–	–	840	45	71.8	0	0
Average cost distribution (%)			100	12.8	69.6	5.8	7.9	3.9					

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* All costs in dollars.

† Paper bags used rather than plastic.

APPENDIX 6

Control of Air Pollution Originating From Federal Installations

Announcement of Signing of Executive Order 11282.
May 26, 1966

President Johnson today signed an Executive order requiring all Federal agencies to take steps to prevent and control air pollution from Federal installations.

The order directs the heads of all Federal agencies to lead in the administration's efforts to improve the quality of the Nation's air. Today's order is similar to one the President issued last November directing the Federal Government to provide effective leadership in the battle against water pollution.

The air pollution Executive order is the result of extensive consultation with Federal agencies and with industries affected by the order. The Department of Health, Education, and Welfare is issuing standards to supplement the order, by setting precise limitations on emissions which will be allowed from Federal buildings and facilities.

Today's order requires that plans for new Federal facilities and buildings in the United States include provisions for air pollution control measures necessary to comply with the standards issued by the Department of Health, Education, and Welfare. In addition, the order directs the head of each agency to examine existing installations and to present to the Bureau of the Budget, by July 1, 1967, an orderly schedule for bringing all such installations up to the required standards.

In signing the order, the President stated that the most difficult problem encountered in writing the order was the lack of an economically feasible technology for controlling emissions of sulfur. The Federal Government has proposed spending more than $3 million in 1967 on research to control sulfur emissions. This includes $1 million for designing four sulfur-removal pilot plants, the construction of which plants would cost a total of $8 million. The President has directed the Secretaries of the Interior and Health, Education, and Welfare to explore with the Bureau of the Budget the feasibility of increasing the Federal effort to find a solution to the sulfur emission problem.

The President said that a major part of the responsibility for sulfur research rests with the utilities, the coal and oil industries, and other groups which will feel the economic efforts of more stringent air pollution regulations. He pointed out that these industries had increased their expenditures for air pollution research in the past few years, but stated that much greater efforts are needed.

The President emphasized that, although there were great technological and economic problems in the abatement of air pollution, the battle for cleaner air remained a major objective of his administration, and an essential element in a better environment for America.

NOTE: For the text of Executive Order 11282, see the following item.

Control of Air Pollution Originating From Federal Installations

Executive Order 11282. May 26, 1966

Prevention, Control, and Abatement of Air Pollution by Federal Activities

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the Clean Air Act, as amended (42 U.S.C. 1857), it is ordered as follows:

Section 1. *Policy.* The heads of the departments, agencies, and establishments of the Executive Branch of the Government shall provide leadership in the nationwide effort to improve the quality of our air through the prevention, control, and abatement of air pollution from Federal Government activities in the United States. In order to achieve these objectives—

(1) Emissions to the atmosphere from Federal facilities and buildings shall not be permitted if such emissions endanger health or welfare, and emissions which are likely to be injurious or hazardous to people, animals, vegetation, or property shall be minimized. The procedures established in section 3 of this Order shall be followed in minimizing pollution from existing facilities and buildings.

(2) New Federal facilities and buildings shall be constructed so as to meet the objectives prescribed by this Order and the standards established pursuant to section 5 of this Order.

(3) The Secretary of Health, Education, and Welfare shall, in administering the Clean Air Act, as amended, provide technical advice and assistance to the heads of other departments, agencies, and establishments in connection with their duties and responsibilities under this Order. The head of each department, agency, and establishment shall establish appropriate procedures for securing advice from, and consulting with, the Secretary of Health, Education, and Welfare.

(4) The head of each department, agency, and establishment shall ensure compliance with section 107(a) of the Clean Air Act, as amended (42 U.S.C. 1857f(a)), which declares it to be the intent of Congress that Federal departments and agencies shall, to the extent practicable and consistent with the interests of the United States and within available appropriations, cooperate with the Department of Health, Education, and Welfare and with any air pollution control agency in preventing and controlling pollution of the air.

Sec. 2. *Procedures for new Federal facilities and buildings.* A request for funds to defray the cost of designing and constructing new facilities and buildings in the United States shall be included in the annual budget estimates of a department, agency, or establishment only if such request includes funds to defray the costs of such measures as may be necessary to assure that the new facility or building will meet the objectives prescribed by this Order and the standards established pursuant to section 5 of this Order. Air pollution control needs shall be considered in the initial stages of planning for each new installation.

Sec. 3. *Procedures for existing Federal facilities and buildings.* (a) In order to facilitate budgeting for corrective and preventive measures, the head of each department, agency, and establishment shall provide for an examination of all existing facilities and buildings under his jurisdiction in the United States and shall develop and present to the Director of the Bureau of the Budget, by July 1, 1967, a phased and orderly plan for installing such improvements as may be needed to prevent air pollution, or abate such air pollution as may exist, with respect to such buildings and facilities. Subsequent revisions needed to keep any such plan up to date shall be submitted to the Director of the Bureau of the Budget with the annual report required by paragraph (b) of this section. Future construction work at each such facility and the expected future use of the facility shall be considered in developing such a plan. Each such plan, and any revision therein, shall be developed in consultation with the Secretary of Health, Education, and Welfare in order to ensure that adoption of the measures proposed thereby will result in the prevention or abatement of air pollution in conformity with the objectives prescribed by this Order and the standards prescribed pursuant to section 5 of this Order.

(b) The head of each department, agency, and establishment who has existing facilities and buildings under his jurisdiction in the United States shall present to the Director of the Bureau of the Budget, by July 1, 1968, and by the first of each fiscal year thereafter, an annual report describing progress of his department, agency, or establishment in accomplishing the objectives of its air pollution abatement plan.

Sec. 4. *Objectives for Federal facilities and buildings.* (a) Except for discharges of radioactive emissions which are regulated by the Atomic Energy Commission, Federal facilities and buildings shall conform to the air pollution standards prescribed by the State or community in which they are located. If State or local standards are not prescribed for a particular location, or if the State or local standards are less stringent than the standards established pursuant to this Order, the standards prescribed pursuant to section 5 of this Order shall be followed.

(b) The emission of flyash and other particulate matter shall be kept to a minimum.

(c) Emission of sulfur oxides shall be minimized to the extent practicable.

(d) Wherever appropriate, tall chimneys shall be installed in order to reduce the adverse effects of pollution. The determination of chimney height shall be based on air quality criteria, land use, and meteorological, topographical, aesthetic, and operating factors.

(e) Solid fuels and ash shall be stored and handled so as not to release to the atmosphere dust in significant quantities. Gasoline or any volatile petroleum distillate or organic liquid shall be stored and handled so as not to release to the atmosphere vapor emissions in significant quantities.

(f) In urban areas refuse shall not be burned in open fires and in rural areas it shall be disposed of in such a manner as to reasonably minimize pollution. Refuse shall not be left in dumps without being covered with inert matter within a reasonably short time. Whenever incinerators are used they shall be of such design as will minimize emission of pollutant dusts, fumes, or gases.

(g) Pollutant dusts, fumes, or gases (other than those for which provision is made above) shall not be discharged to the atmosphere in quantities which will endanger health or welfare.

(h) The head of each department, agency, and establishment shall, with respect to each installation in the United States under his jurisdiction, take, or cause to be taken, such action as may be necessary to ensure that discharges of radioactive emissions to the atmosphere are in accord with the rules, regulations, or requirements of the Atomic Energy Commission and the policies and guidance of the Federal Radiation Council as published in the Federal Register.

(i) In extraordinary cases where it may be required in the public interest, the Secretary of Health, Education, and Welfare may exempt any Federal facility or building from the objectives of paragraphs (a) through (g) of this section.

Sec. 5. *Standards.* (a) The Secretary of Health, Education, and Welfare shall prescribe standards to implement the objectives prescribed by paragraphs (a) through (g) of section 4 of this Order. Such standards may modify these objectives whenever the Secretary of Health, Education, and Welfare shall determine that such modifications are necessary in the public interest and will not significantly conflict with the intent of this Order. Prior to issuing any changes in such standards, the Secretary of Health, Education, and Welfare shall consult with appropriate Federal agencies and shall publish the proposed changes in the Federal Register thirty days prior to their issuance. All such standards prescribed by the Secretary shall be published in the Federal Register.

(b) The permits authorized by section 107(b) of the Clean Air Act, as amended (42 U.S.C. 1857f(b)), may be used to carry out the purposes of this Order as the Secretary of Health, Education, and Welfare may deem appropriate.

Sec. 6. *Prior Executive Order superseded.* Executive Order No. 10779 of August 20, 1958, is hereby superseded.

Lyndon B. Johnson

The White House
May 26, 1966

[Filed with the Office of the Federal Register, 8:49 a.m., May 27, 1966]

Title 42—PUBLIC HEALTH

Chapter I—Public Health Service, Department of Health, Education, and Welfare

SUBCHAPTER F—QUARANTINE, INSPECTION, AND LICENSING

PART 76—PREVENTION, CONTROL, AND ABATEMENT OF AIR POLLUTION FROM FEDERAL GOVERNMENT ACTIVITIES: PERFORMANCE STANDARDS AND TECHNIQUES OF MEASUREMENT

Pursuant to section 5 of Executive Order No. 11282, the Secretary of Health, Education, and Welfare hereby amends Subchapter F of Title 42, Code of Federal Regulations, by adding a new Part 76, as follows:

Sec.
76.1 Definitions.
76.2 Intent.
76.3 Applicability.
76.4 Combustion of fuel.
76.5 Sulfur oxides.
76.6 Stacks.
76.7 Storage and handling of fuels and ash.
76.8 Disposal of refuse.
76.9 Other pollution producing processes.

AUTHORITY: The provisions of this Part 76 issued under section 5 of Executive Order 11282.

§ 76.1 Definitions.

As used in this part:

(a) "Executive Order" means Executive Order No. 11282.

(b) Nonurban areas" means all areas other than urban areas.

(c) "Ringelmann Scale" means the Ringelmann Scale as published in the latest U.S. Bureau of Mines Information Circular entitled "Ringelmann Smoke Chart".

(d) "Secretary" means the Secretary of Health, Education, and Welfare.

(e) "Smoke Inspection Guide" means the U.S. Public Health Service Smoke Inspection Guide described in Part 75 of this title.

(f) "Urban areas" means those areas classified as urban in the latest available Federal census, or as Standard Metropolitan Statistical Areas by the Bureau of the Budget.

(g) "Unit" means all indirect heat exchangers connected to a single stack.

(h) "Particulate matter" means any material, except uncombined water, that exists as a solid or liquid at standard conditions.

(i) "Standard conditions" means a temperature of 70° Fahrenheit and a pressure of 14.7 pounds per square inch, absolute.

(j) "Waste" means any solid, liquid, or gaseous substance, the disposal of which may create an air pollution problem.

§ 76.2 Intent.

It is the intent of these standards that emissions to the atmosphere from Federal facilities and buildings shall not be permitted if such emissions endanger health or welfare and that emissions which are likely to be injurious or hazardous to people, animals, vegetation, or property shall be minimized.

§ 76.3 Applicability.

(a) Unless otherwise indicated, the standards in this part apply to both new and existing Federal facilities and buildings. These standards are effective upon publication in the FEDERAL REGISTER, except for those facilities and buildings which are likely to require installation of improvements under the plan to be submitted in accordance with section 3 of the Executive Order.

(b) Except for discharges of radioactive effluents which are regulated by the Atomic Energy Commission, Federal facilities and buildings shall conform to the air pollution standards prescribed by the State or community in which they are located. If State or local standards are not prescribed for a particular location, or if the State or local standards are less stringent than the standards prescribed herein, the standards in this part shall be applicable to discharges from such Federal facilities and buildings except as otherwise indicated.

(c) Temporary operations that may result in potential air pollution problems, such as those associated with research, development, test, evaluation, space, and military activities, shall be conducted with such precautions and safeguards as are needed to achieve the intent of these standards.

(d) The Secretary may, upon application of the relevant department, agency or establishment, exempt any Federal facility or building from the objectives contained in section 4 of the Executive order and from any or all of these standards whenever he determines that the activities of such building or facility will not significantly conflict with the intent of the Executive order and that such an exemption is in the public interest.

§ 76.4 Combustion of fuel.

(a) The following standards apply to the combustion units of facilities and buildings having a heat input of less than 1,000 million B.t.u./hour, other than fireplaces, stoves, or grills burning wood or charcoal:

(1) Manually fired equipment shall not be installed as new or replacement equipment, except for the burning of anthracite, coke, or smokeless fuel.

(2) (i) For new units, except during startup, cleaning of fires, or soot blowing, the density of any emission to the atmosphere shall not exceed No. 1 on the Ringelmann Scale or the Smoke Inspection Guide.

(ii) For existing units, except during startup, cleaning of fires, or soot blowing, the density of any emission to the atmosphere shall not exceed No. 2 on the Ringelmann Scale or Smoke Inspection Guide.

(3) A photoelectric or other type smoke detector, recorder, or alarm shall be installed on units larger than ten million BTU per hour input, except where gas or light oil (No. 2 or lighter), is burned.

(4) During routine operation, the emission of particles larger than 60 microns shall not normally occur.

(5) Means shall be provided in all newly constructed units and wherever practicable in existing units to allow the periodic measurement of flyash and other particulate matter.

(6) All new or replacement spreader stoker installations shall be of a type that automatically discharges ashes to the ash pit either continuously or in very frequent small increments, and flyash shall be reinjected only from boiler passes.

(7) For units of less than 10 million BTU/hour heat input, the emission of flyash and other particulate matter shall not exceed 0.6 pounds of particulate matter per million BTU heat input, as measured by the American Society of Mechanical Engineers Power Test Code No. 27 for "Determining Dust Concentrations in a Gas Stream," or equivalent test method.

(8) For units between 10 million and 1,000 million BTU/hour heat input, the emission of flyash and other particulate matter shall not exceed that specified in figure 1, as measured by the test method

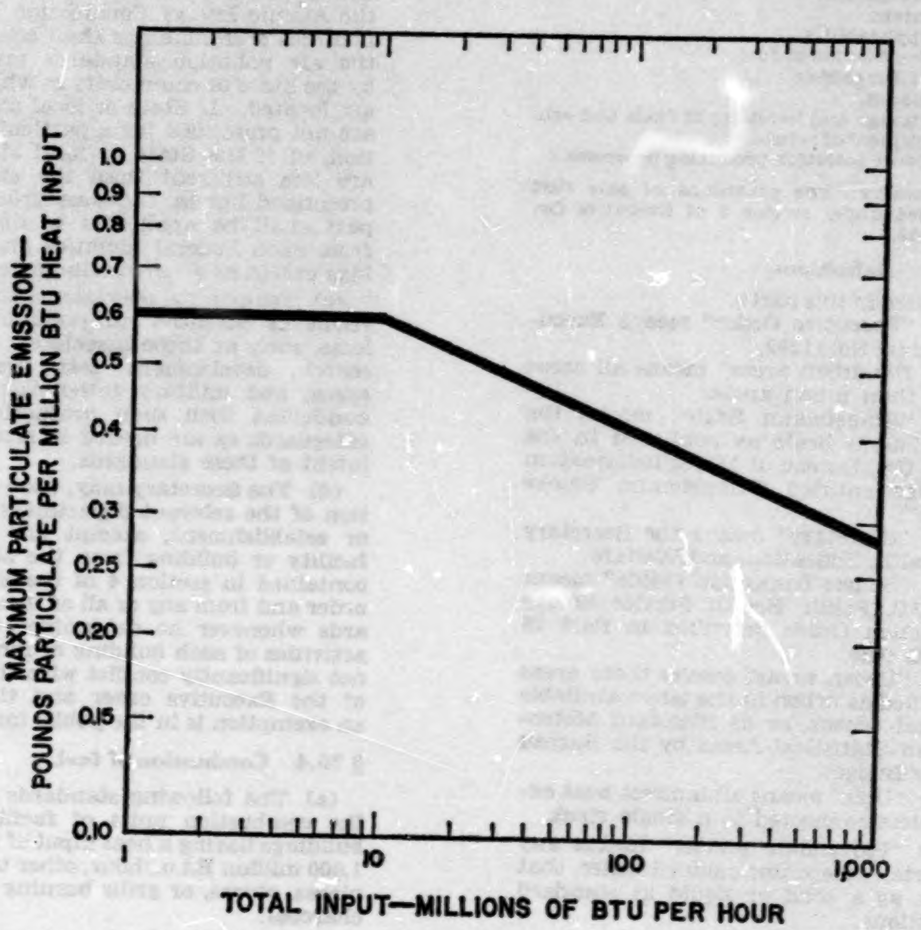

Figure 1. Maximum emission of particulate matter from fuel burning installations.

specified in subparagraph (7) of this paragraph. Existing units shall meet this standard within the time designated by the plan submitted in accordance with section 3 of the Executive order except that with respect to existing spreader stoker units the plan may specify certain units which may emit particulate matter at an interim rate not exceeding 0.6 lbs/million BTU heat input.

(b) For units having a heat input of more than 1,000 million BTU/hour, the appropriate department, agency, or establishment shall seek special advice from the Secretary with regard to smoke, flyash, and other particulate emissions.

§ 76.5 Sulfur oxides.

(a) Combustion units of facilities or buildings not located in areas specified by the Secretary under paragraph (c) of this section and whose heat input is less than 1,000 million BTU/hour shall burn the lowest sulfur content fuel that is reasonably available. In determining reasonable availability, the factors to be considered include, among others, price, firmness of supply, extent of existing pollution, and assurance of supply under adverse weather and natural disaster conditions.

(b) For combustion units or Federal facilities or buildings not located in areas specified by the Secretary under paragraph (c) of this section and whose heat input is more than 1,000 million BTU/hour, the appropriate department, agency, or establishment shall seek special advice from the Secretary with regard to sulfur-oxide emissions.

(c) (1) Effective October 1, 1969, combustion units of all Federal facilities or buildings located in the following areas shall comply with applicable emission limitations and control measures set out below:

(i) In the New Jersey-New York-Connecticut Interstate Air Quality Control Region as defined by 42 CFR Part 81, the emission rate of sulfur oxides (calculated as sulfur dioxide) from fuels used in combustion units shall not exceed 0.35 pounds per million B.t.u. (gross value) heat input.

(ii) In the Metropolitan Chicago Interstate Air Quality Control Region (Indiana-Illinois) and in the Metropolitan Philadelphia Interstate Air Quality Control Region (Pennsylvania-New Jersey-Delaware) as defined in 42 CFR Part 81, the emission rate of sulfur oxides (calculated as sulfur dioxide) from fuels used in combustion units shall not exceed 0.65 pounds per million B.t.u. (gross value) heat input.

(2) Such limits or measures shall be established only after consultation with appropriate Federal, State and local officials and affected parties. Not less than 30 days prior to prescribing such limits or measures, the Secretary will publish in the Federal Register notice of his intention to adopt such limits or measures, and will thereafter publish in the Federal Register the limits or measures established. The Secretary may at any time designate other urban areas which suffer from extremely high air pollution levels, and after similar consultation, and publication in the Federal Register, prescribe such limits or measures as he determines are necessary to carry out the intent of this order.

(d) The emission of the oxides of sulfur the atmosphere shall be monitored at regular intervals by determining the sulfur content of the fuel used or by determining the sulfur content of flue gases.

§ 76.6 Stacks.

For buildings or facilities in nonurbanized areas, the particle emission standards of § 76.4(a) (7) and (8) may be revised for an individual installation by an amount to be determined by the Secretary, when:

(a) The stack height exceeds by 2½ times the height of the highest building in that area, and

(b) The pollution level in any area will not be significantly increased thereby.

For large plants the determination of chimney height shall be based on air quality criteria, land use, and meteorological, topographical, aesthetic, and operating factors.

§ 76.7 Storage and handling of fuels and ash.

(a) Solid fuels and ash shall be stored and handled so as not to release to the atmosphere dust in significant quantities.

(b) In quantities of 40,000 gallons or more, gasoline or any volatile petroleum distillate or organic liquid having a vapor pressure of 1.5 p.s.i.a. or greater under actual storage conditions shall be stored in pressure tanks or reservoirs or shall be stored in containers equipped with a floating roof or vapor recovery system or other vapor emission control device.

(c) Stationary gasoline storage tanks with a capacity of 250 gallons or more shall be equipped with either submerged filling inlets or with vapor recovery or emission control systems such that loss of vapor to the atmosphere during filling operations shall be minimized.

(d) Gasoline or petroleum distillate tank car or tank truck loading facilities handling 20,000 gallons per day or more shall be equipped with submersible filling arms or other vapor emission control systems.

§ 76.8 Disposal of waste.

(a) (1) Waste shall not be burned in open fires in urban areas.

(2) In nonurban areas, there shall not be burned in open fires, within a 24-hour period, more than 25 pounds of waste at a single site nor more than 500 pounds

of waste at any number of sites within a 1-mile radius, except that these quantities may be exceeded in the case of onsite burning of waste produced in connection with operations performed at railroad rights-of-way interurban highways, irrigation canals, forests, agricultural sites, etc., and provided that care is exercised to prevent creation of localized air pollution which endangers health or welfare. Deteriorated or unused explosives, munitions, rocket propellants, burned in open fires, in accordance with recognized procedures.

(3) Wastes shall not be left in open dumps.

(4) Wastes that are disposed of in sanitary landfills shall be disposed of in accordance with procedures described in "Sanitary Landfill Facts" (PHS publication No. 1792, 1968) and any amendments or revisions thereof. Said document is available to any interested person, whether or not affected by the provisions of this part, upon request to the National Air Pollution Control Administration, Arlington, Va. 22203, which maintains an official historic file of the document, or to the Public Health Service Information Center as listed in 45 CFR 5.31 (32 F.R. 9316).

(b) (1) Waste shall be burned only in facilities especially designed for that purpose, except as provided in paragraph (a) of this section.

(2) For incinerators acquired on or after June 3, 1966 the density of any emission to the atmosphere shall not exceed number 1 on the Ringelmann Scale or the Smoke Inspection Guide for a period or periods aggregating more than 3 minutes in any 1 hour, or be of such opacity as to obscure an observer's view to an equivalent degree.

(3) For incinerators acquired prior to June 3, 1966 the density of any emission to the atmosphere shall not exceed number 2 on the Ringelmann Scale or the Smoke Inspection Guide for a period or periods aggregating more than 3 minutes in any 1 hour, or be of such opacity as to obscure an observer's view to an equivalent degree.

(c) (1) In addition, for installations burning more than 200 pounds of waste per hour, emissions shall not exceed 0.2 grain of particulate matter per standard cubic foot of dry flue gas corrected to 12 percent carbon dioxide (without the contribution of carbon dioxide from auxiliary fuel), measured in accordance with the test procedures described in "Specifications for Incinerator Testing at Federal Facilities" (PHS publication, October, 1967) and any amendments or revisions thereof. Said document is available to any interested person, whether or not affected by the provisions of this part, upon request to the National Air Pollution Control Administration, Arlington, Va. 22203, which maintains an official historic file of the document, or to the Public Health Service Information Center or Regional Office Information Center as listed in 45 CFR 5.31 (32 F.R. 9316).

(2) For installations burning 200 pounds of waste per hour or less, emissions shall not exceed 0.3 grain of particulate matter per standard cubic foot of dry flue gas corrected to 12 percent carbon dioxide (without the contribution of carbon dioxide from auxiliary fuel), measured in accordance with the test specifications described in "Specifications for Incinerator Testing at Federal Facilities" (PHS publication, October 1967) and any amendments or revisions thereof.

(3) Test procedures which are approved by the Commissioner, National Air Pollution Control Administration, as equivalent to those prescribed by paragraphs (c) (1) and (c) (2) of this section may be used for the purpose of determining an installation's compliance with the emission standards for particulate matter contained in such paragraphs.

§ 76.9 Other pollution producing processes.

For dusts, fumes, or gases from any process not heretofore described, except for discharges of radioactive effluents regulated by the Atomic Energy Commission, whatever measures may be necessary to comply with the intent of these regulations shall be applied. This will generally require the installation of equipment or devices to minimize such emissions to the point where they will meet the standards contained in these regulations. For processes which emit toxic substances in quantities which might endanger health or welfare and for fires which emit smoke or fumes at official firefighting schools, the appropriate department, agency, or establishment shall seek special advice from the Secretary.

(NOTE: The Department of Health, Education, and Welfare will, from time to time, and after consultation with industries concerned, issue "Guides of Good Practice" for specific operations to aid Federal departments, agencies, and establishments in the selection of equipment and methods for meeting the performance standards. For emissions not covered herein, or for which there have been issued no applicable "Guides of Good Practice," the Department of Health, Education, and Welfare will provide technical material and consultation to departments, agencies, and establishments requesting such assistance. Requests for "Guides of Good Practice," technical material, or consultation should be directed either to the Federal Facilities Section, Abatement Branch, Division of Air Pollution, Public Health Service, Department of Health, Education, and Welfare, Washington, D.C., 20201, or to the appropriate Regional Air Pollution Program Director of the Public Health Service located in the Department of Health, Education, and Welfare Regional Offices.)

Dated: March 28, 1969.

JOHN W. GARDNER,
Secretary of Health, Education, and Welfare.

[F.R. Doc. 69-3918; Filed, Apr. 3, 1969; 8:46 a.m.]